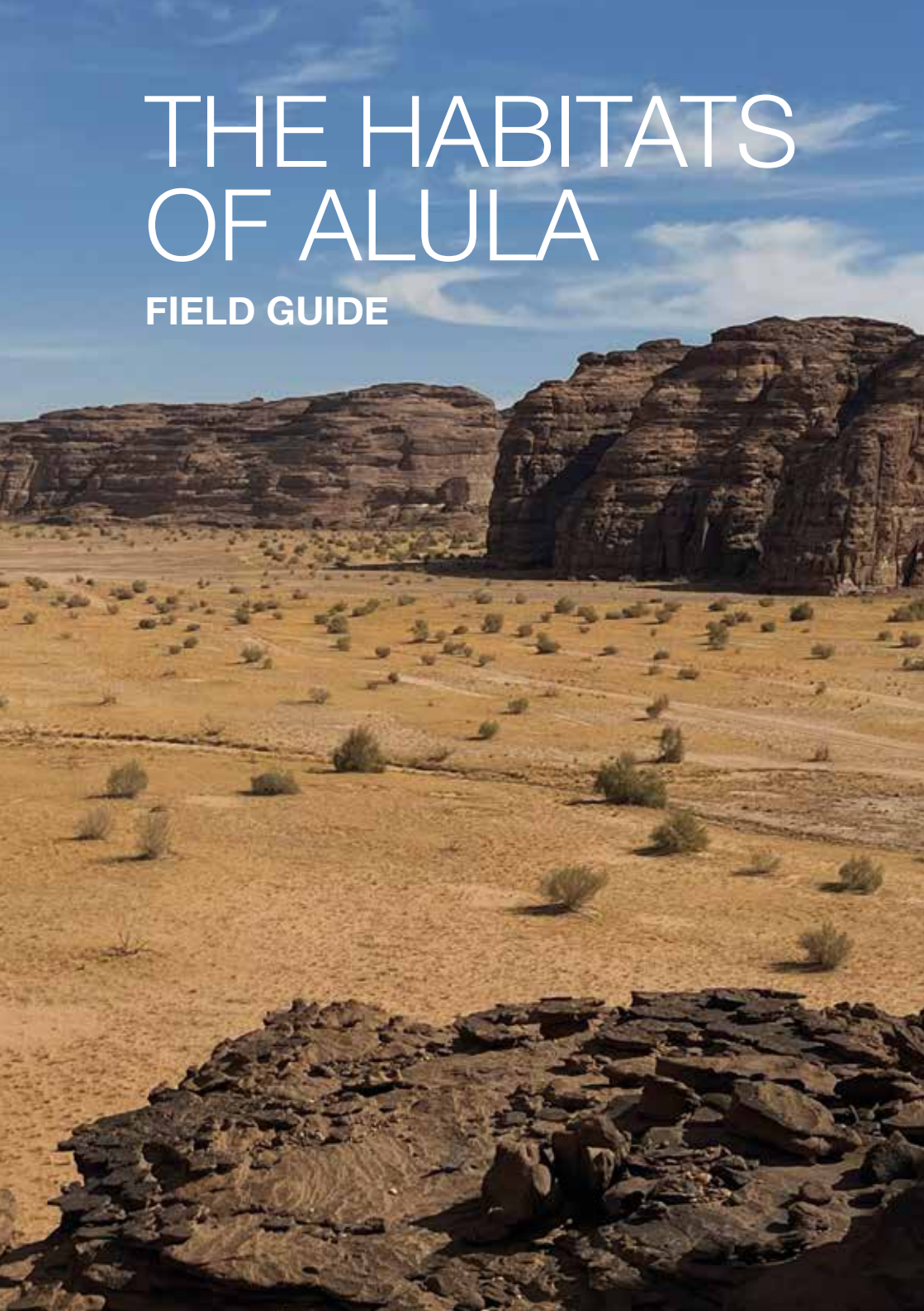
THE HABITATS OF ALULA

FIELD GUIDE



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FIELD GUIDE

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الهيئة الملكية لمحافظة العلا
ROYAL COMMISSION FOR ALULA

AFALULA

CENTRE FOR MIDDLE EASTERN PLANTS

BIOPOLIS

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ABBREVIATIONS AND ACRONYMS

AFALULA	French Agency for AlUla Development
CMEP	Centre for Middle Eastern Plants
EUNIS	European Nature Information System
GNR	Gharameel Nature Reserve
HUBR	Harrat Uwayrid Biosphere Reserve
HZNR	Harrat AlZabin Nature Reserve
IUCN	International Union for Conservation of Nature
IUCN Red List Categories	**CR** = Critically Endangered **EN** = Endangered **VU** = Vulnerable **NT** = Near Threatened **LC** = Least Concern **DD** = Data Deficient **NE** = Not Evaluated.
KSA	Kingdom of Saudi Arabia
NA	Not Assessed
NCW	National Centre for Wildlife
NDVI	Normalised Difference Vegetation Index
RCU	Royal Commission for AlUla
SNP	Sharaan National Park
WNNR	Wadi Nakhlah Nature Reserve



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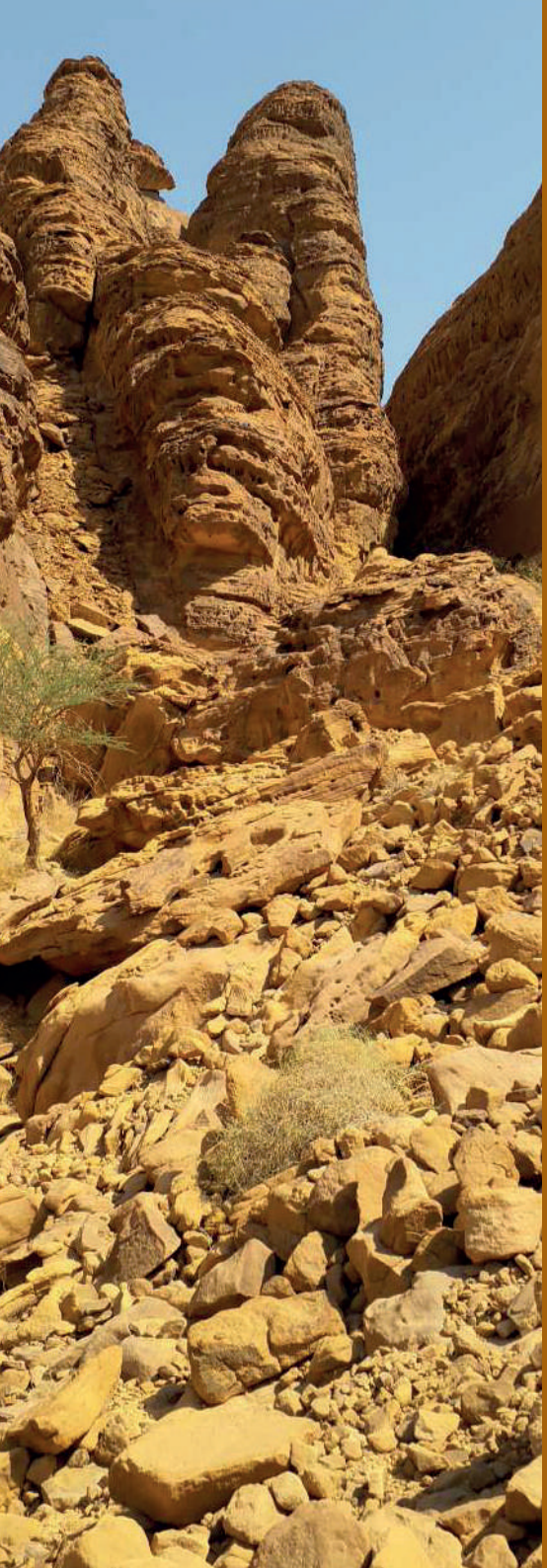
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FOREWORD

The transformation of AlUla is founded on a simple yet ambitious vision: that economic development, cultural heritage and environmental stewardship must progress together. In this vision, shared by the Royal Commission for AlUla and the French Agency for AlUla Development (AFALULA), the preservation and restoration of nature are not only environmental imperatives, but essential foundations for the long-term resilience, attractiveness and prosperity of the region.

AlUla's extraordinary landscapes—its sandstone canyons, volcanic harrats, mountains, wadis, dunes and oases—support a remarkable diversity of habitats that have shaped both biodiversity and human civilisation for millennia. Understanding these habitats is therefore fundamental to protecting the ecological processes that sustain biodiversity, guiding restoration efforts, informing land-use planning and ensuring that future development remains compatible with the natural character of this exceptional territory.

The Habitats of AlUla marks an important milestone in this journey. Developed through the close collaboration between the Royal Commission for AlUla (RCU), AFALULA and a multidisciplinary team of international and Saudi experts, this manual provides, for the first time, a comprehensive and standardized habitat classification for AlUla County. By bringing together the knowledge

generated through numerous scientific programmes into a single coherent framework, it establishes a common language that can be shared by ecologists, planners, engineers, landscape architects, decision-makers and all those contributing to AlUla's future.

Beyond its scientific value, this publication reflects the strength of the long-standing partnership between France and the Kingdom of Saudi Arabia. Since the creation of AFALULA, our mission allowed to mobilize French expertise in support of the Royal Commission for AlUla's vision while fostering knowledge exchange, innovation and capacity building. This manual exemplifies that ambition: combining international scientific standards with local knowledge and field experience to produce a practical tool that will support biodiversity conservation, ecological restoration and sustainable territorial planning for years to come.

As new research, monitoring programs and field observations continue to enrich our knowledge, this habitat framework is itself intended to evolve alongside them. We hope that this manual will become a living reference—supporting informed decision-making, encouraging collaboration across disciplines, and inspiring future generations of scientists, practitioners and institutions committed to safeguarding AlUla's unique natural heritage.



On behalf of our Agency, I would like to warmly thank the Royal Commission for AlUla, our scientific partners and all the experts, notably from the Royal Botanic Garden Edinburgh, Valorhiz and Biopolis, whose dedication, expertise and collaborative spirit have made this achievement possible. Their collective work provides a crucial contribution to the conservation and sustainable development of one of the world's most spectacular landscapes, at the heart of a human adventure spanning several centuries.

We are proud to present this manual and trust that it will serve as a lasting reference for all those working to protect, restore and celebrate the remarkable natural heritage of AlUla & Saudi Arabia.

Jean-Yves Le Drian
President
French Agency for AlUla Development (AFALULA)



ALULA COUNTY

ALULA'S CONSERVATION AREAS

AlUla County lies in the north-western part of Al Madinah Province and covers approximately 22,561 km². The county contains a network of protected areas and sites of conservation significance that together form the focus of biodiversity conservation and ecological restoration initiatives led by the Royal Commission for AlUla (RCU). There are five protected areas within AlUla County, as well as three additional areas designated as being of conservation significance (Figure 1).



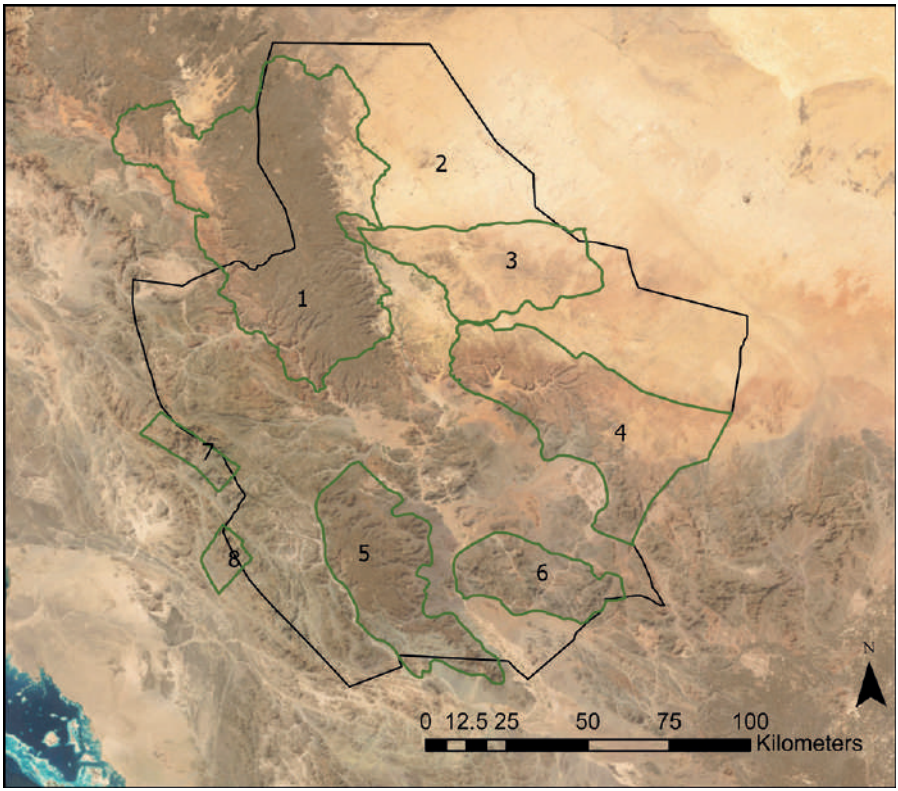


Figure 1 | Location of AlUla County showing the extent of designated nature reserves and areas of conservation significance. Nature reserves include 1. Harrat Uwayrid Biosphere Reserve (HUBR) 2. Gharameel Nature Reserve (GNR) 3. Sharaan National Park (SNP) 4. Wadi Nakhlah Nature Reserve (WNNR) 5. Harrat AlZabin Nature Reserve (HZNR). Areas of conservation significance include 6. Jabal Nahar 7. Jabal AlWard and 8. Jabal Shayoub.

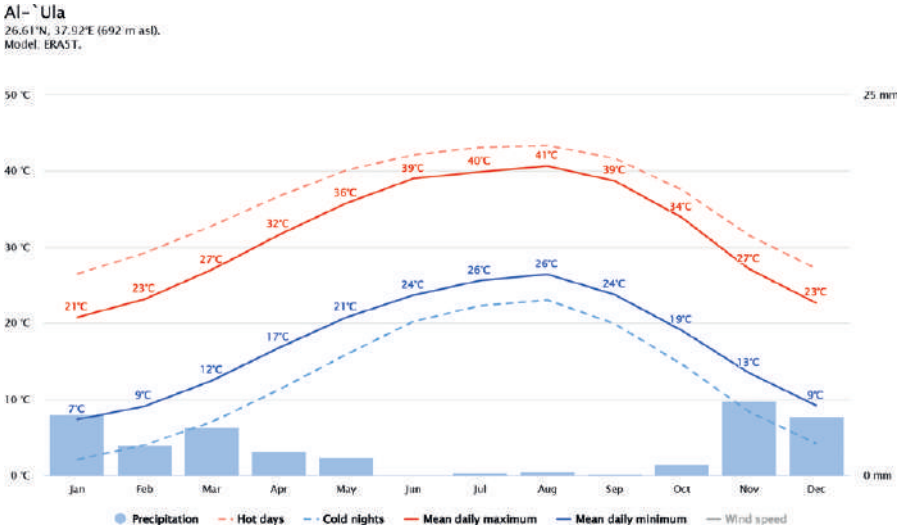


Figure 2 | Climate profile for AlUla County. Source: Meteoblue climate data for AlUla, Saudi Arabia (www.meteoblue.com), accessed July 2026.

CLIMATE

AlUla has a hot desert climate typical of much of Saudi Arabia (Beck et al., 2018). The climate is characterised by very hot summers, mild winters, extremely low humidity, and minimal rainfall throughout the year (Figure 2).

Temperatures in AlUla in summer (June – September) are very hot with an average daytime maximum commonly reaching 41 °C and average low of 24 °C. Winter temperatures are comparatively mild with daytime highs up to 23 °C, while nighttime temperatures can fall below 4 °C.

Rainfall in AlUla is extremely limited, averaging 20–30 mm per year with most precipitation occurring in short episodes in winter and early spring. Rare, intense rainfall events can trigger wadi flows and localised flooding, which have historically shaped the area's geomorphology and cultural settlement patterns. Meteorological observations within AlUla are limited, and much of the available climate information is derived from modelled datasets. There is variation through the county with higher altitude areas experiencing cooler temperatures.

GEOLOGY

AlUla's landscape represents a complex geological history spanning nearly one billion years, covering a large variety of igneous, metamorphic and sedimentary rock types, exposed across a relatively small area (Figure 3).

The oldest formations in AlUla are found in the south of the region. These Late Precambrian igneous and metamorphic complexes, a part of the Arabian Shield, create jagged mountains (Hadley, 1987). The Precambrian basement rocks are overlain by Cambrian and Ordovician sandstones (Hadley, 1987). Evidence of large series of faulting through tectonic activity can be seen across the entire AlUla region. The Late Precambrian Najd fault system, one of the largest Proterozoic shear zones on Earth, spreading through Saudi Arabia and Egypt (Stern, 1985; Stüwe et al., 2014), caused folding and fractures in the rocks in the south of AlUla. Later, faulting during the Oligocene/Miocene, resulting from the Red Sea rifting, produced further faulting in the sandstones (Rasul, Stewart, and Nawab 2015).

The oldest rocks in AlUla, in the south, creating a mountainous landscape, with sandy and gravel plains.





Cambrian sandstone formations exposed where aeolian erosion has carved out canyons, sandy wadis, and plains.

Overlaying the Precambrian rocks are the oldest sandstones, the Siq Sandstone, which is very well cemented, red in colour due to high iron content, and heavily fractured. These sandstones from the Early Cambrian, around 540-510 million years old, demonstrate medium to coarse-grained beds, with large cross-bedding throughout, evidence of a large, high-energy fluvial channel (Hadley, 1987). The lighter, Quweria Sandstone lies unconformably above the Siq Sandstone, and is dominated by fluvial deposits (Vaslet et al., 1994). The youngest sedimentary formation, the Saq Sandstone, demonstrates fluctuating environments, from shallow seas to river deltas, with medium-grained, well-rounded sands, graded bedding, and ripple marks at some sites (Hadley, 1987). Less compacted and cemented, the Saq Sandstone demonstrates different erosion to the older Siq sandstones, resulting in a large number of geomorphological landforms.

In the hyper-arid environment, the geology is exposed in the landscape, creating the diverse habitats of the region. The southern area displays a more mountainous look due to the weathering of the crystalline igneous and metamorphic formations, and towards the north, the Cambrian and Ordovician sandstones demonstrate numerous types of aeolian formations.

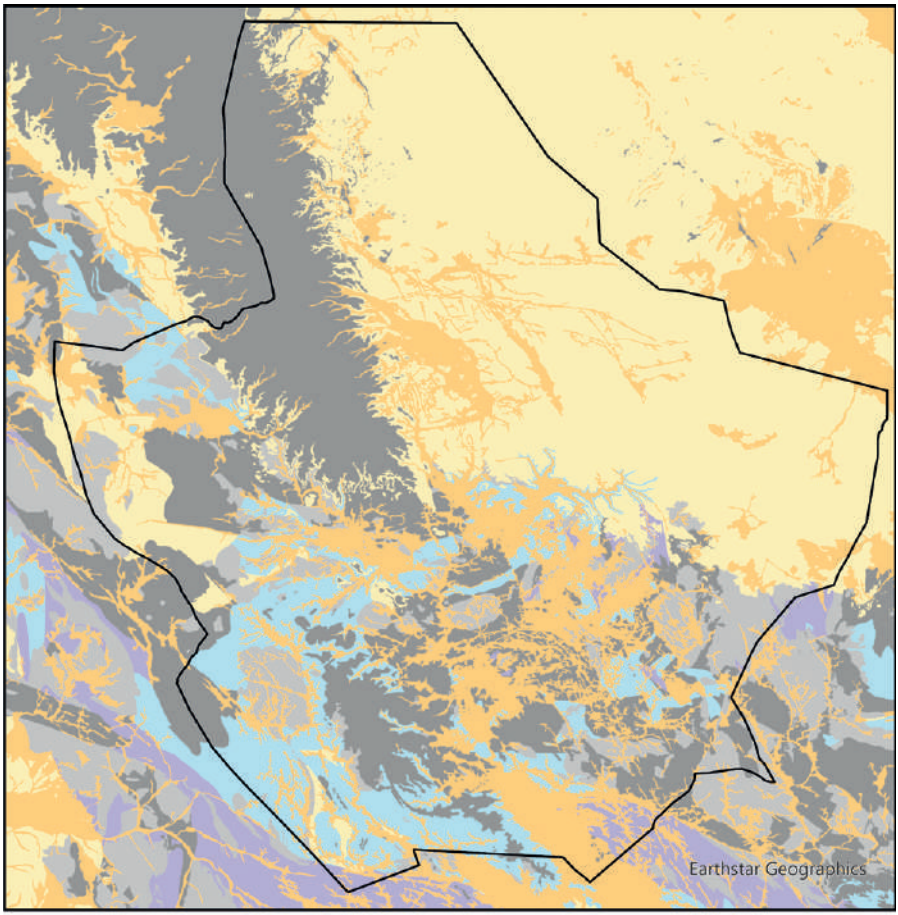


Figure 3 | Overview of the geological diversity of AlUla showing the distribution of lithological families across the county (black outline). Source: Geology 250k map provided by the Saudi Geological Survey, National Geological Database. Copyright Saudi Geological Survey. https://ngp.sgs.gov.sa/



Tertiary basalt lava flows (known as harrats), which cover the Saq sandstones in several places, create extensive plateaus: the largest of these is the Harrat Uwayrid Biosphere Reserve (Sen et al., 2025). These basalts date from around 10 million years ago until 500,000 years ago and are the result of crustal melting from the rifting of the Red Sea (Altherr et al., 2019), and volcanoes can still be seen on Harrat Uwayrid. Throughout the region, several fine to coarse-grained alluvium deposits can be seen, which



formed during the Quaternary. This material is typical in valley (or wadi) environments and can range from large water-travelled boulders to fine wind-blown sand (Bramkamp et al., 1963; Al-Bassam, Khalil, and Kassem, 2014).

Harder metamorphic rocks survive as hills surrounded by gravel and sandy plains in the south of AlUla. It shows the diversity of the landscapes, and the habitats, of AlUla.

FLORA AND FAUNA

AlUla lies within the Palaearctic realm and is dominated by the deserts and xeric shrublands biome. Its exceptional biogeographical position places it at the transition of several of this biome's ecoregions: Arabian Desert, North Arabian Desert, Red Sea-Arabian, and Desert Shrublands (Dinerstein et al., 2017). Portions of Jabal AlWard fall within the Mediterranean forests, woodlands and scrub biome and belong to a fifth ecoregion, the Eastern Mediterranean conifer broadleaf forests. AlUla also lies roughly midway between two global biodiversity hotspots, namely the Mediterranean basin and the Horn of Africa (which extends into the south western Arabian Peninsula).

From a biogeographic perspective, the flora and fauna of AlUla comprise a mixture of widely distributed desert taxa and regionally restricted species, alongside elements with affinities to Mediterranean, Irano–Turanian and Sudanian floristic regions (Miara et al., 2025). This reflects both the historical connectivity of the Arabian Peninsula and the role of AlUla as a transition zone influenced by multiple biogeographic regions.

1 *Nepeta sheilae* a national endemic





The flora of AlUla is diverse but characteristically adapted to arid environments, comprising 460 recorded vascular plant taxa across 65 families and 277 genera (Stott et al., 2026). This represents approximately 20% of the flora of Saudi Arabia, seven species endemic to the Kingdom, and three endemic to the Arabian Peninsula. Recent botanical surveys have significantly improved knowledge of these taxa, documenting important new populations and range extensions for several national endemics, including *Euryops jaberiana* and *Nepeta sheilae*.



2 Sooty Falcon (*Falco concolor*).
3 *Euryops jaberiana* a national endemic.

In addition, more than 70 species recorded in AlUla are considered range restricted, occurring only within north-western Saudi Arabia and neighbouring countries such as Jordan and Egypt. For some species, including *Phlomis brachyodon*, AlUla represents the southernmost known extent of their distribution, while for others, such as *Ferula sinaica*, populations in AlUla are of national conservation importance because of the species' limited distribution within Saudi Arabia.

Although the majority of AlUla's plant species are widespread, most have not yet been assessed using the IUCN Red List Categories and Criteria. Two of the Saudi endemic taxa are currently recognised as globally threatened or Near Threatened, while many others remain classified as Data Deficient, reflecting broader gaps in botanical knowledge, taxonomic research and distribution data across the region.

The presence of threatened and range-restricted taxa, including species such as *Thymbra nabateorum*, highlights both the importance of AlUla for plant conservation and the continuing potential for new botanical discoveries (Abdulkarem et al., 2025).

Recent cryptogam surveys have also revealed an unexpectedly high diversity in AlUla, with 48 bryophyte species recorded in AlUla County and more than 100 lichens documented across the AlUla-Khaybar region (Hugonnot et al., 2025a, 2025b; Hugonnot et al., 2026a, 2026b; Marques et al., 2025, 2026). These findings highlight the importance of AlUla's varied geology, topography and microclimatic refugia in supporting a diverse cryptogam assemblage within an otherwise arid landscape. Several bryophytes, including *Riella affinis*, *Gymnostomiella vernicosa*, *Hymenostylium hildebrandtii* and *Ptychostomum cellulare*, have been identified as being of exceptional conservation importance within AlUla, owing to their rarity, restricted distributions, and dependence on specialised refugial habitats.

Although generally less conspicuous than vascular plants, bryophytes and lichens make an important contribution to AlUla's biodiversity. They occur primarily within environmentally favourable microhabitats, including shaded sandstone canyons, seepages, spring systems, runoff channels, sheltered rock faces, and higher-altitude mountain environments. Lichens form an important component of AlUla's cryptogam diversity and are particularly associated with biological soil crusts, rock surfaces and moisture-enhanced microhabitats. Lichens including *Peltula euploca*, *Peltula africana*, *Lichinella cribellifera*, *Lichinella stipatula* and *Thallinocarpon nigritellum* are characteristic of seepage tracks and runoff channels, while *Psora decipiens* and *Catapyrenium squamulosum* are key constituents of biological soil crust communities. Together, these assemblages contribute to soil stabilisation, nutrient cycling, and the ecological functioning of AlUla's desert ecosystems (Marques et al., 2026).

Due to its geographic position, AlUla also supports high faunal diversity. The current faunal list of AlUla comprises 622 taxa identified to the levels of species or genus (Brito et al., 2024). IUCN range maps indicate up to 32 mammal species potentially present in AlUla. The Arabian leopard (*Panthera pardus nimr*) is a prominent flagship species with historic observations in the AlUla region (Al-Johany 2007), suggesting the area acts as a suitable habitat or a dispersal corridor, despite its absence in AlUla for decades. Historical records of the cheetah (*Acinonyx jubatus*) and the Asian wild ass (*Equus hemionus*) indicate potential for future reintroductions, as well as for the reintroduction of the leopard (Dunford et al. 2022). IUCN range maps also list 122 bird species occurring in AlUla. Notable bird species include the Asian houbara (*Chlamydotis macqueenii*), a flagship desert species with cultural and tourism value (Goriup et al. 1997), and the Sooty falcon, with an estimated 2% of the world's population occurring in AlUla (Martins et al., 2026). The native Arabian ostrich (*Struthio camelus syriacus*) is extinct, but habitat restoration could allow reintroduction of other arid adapted subspecies (Zafar-ul Islam et al., 2008). Western KSA and AlUla lie on major migratory flyways (e.g. Launay et al. 1999; Javed et al. 2012), and oases, wadis, and plantations provide critical stopover and resting sites during seasonal migrations. In addition, reptile diversity in the Arabian Peninsula is high, with more than 50% of its recognised species found nowhere else in the world (Cox et al., 2012). Endemism is particularly pronounced among lizards, while 23% of snakes are endemic (Mallon 2011). Emblematic endemics include the Arabian cobra (*Naja arabica*), Yemen monitor (*Varanus yemenensis*), and Veiled chameleon (*Chamaeleo calyptratus*). Amphibian diversity is low due to regional aridity, and only the Arabian toad (*Sclerophrys arabica*) and the Arabian five-fingered frog (*Euphlyctis ehrenbergii*) are known from the AlUla region (Aloufi and Amr 2015; Aloufi et al., 2021; IUCN 2024). Although considerable progress has been made in documenting AlUla's fauna, research has focused predominantly on larger vertebrates, and further survey and taxonomic work is needed to better understand the diversity and distribution of lesser-known invertebrates.

ENVIRONMENTAL DEGRADATION

Degradation and habitat descriptions

Environmental degradation is a defining contextual feature of AlUla's landscapes. This section provides an overview of the principal forms and drivers of environmental degradation in AlUla County and explains how degradation influences the *condition* of habitats, their ecological integrity, and their restoration potential. It does not alter the definition of habitat classes themselves.

Long-term human–environment interactions

Human presence in the AlUla region extends back millennia, and the landscape has evolved in association with human land use. For centuries, and likely longer, nomadic and seminomadic pastoral systems operated across the region using adaptive strategies closely tuned to rainfall variability and forage availability (AboHassan,1981; Ministry of Agriculture and Fisheries, 1982). Practices such as seasonal herd movement, rotational grazing, and the likely use of socially regulated access systems - including variants of the *hima* system (Gari, 2006; Lancaster,1999), helped to maintain ecological resilience and balance livestock use with the availability of natural resources.

1 Camel grazing in gravel wadi
2 Off-road driving tracks on sand dunes




2

As a result, many ecosystems in AlUla represent long-established cultural landscapes, shaped through sustained yet regulated interaction between people, livestock, and arid ecosystems. These systems maintained ecological resilience over extended periods, meaning that much of the vegetation cannot be considered natural in the strictest sense, but instead reflect cultural landscapes (AboHassan, 1981; Lancaster, 1999).

Contemporary drivers of degradation

In contrast to these long-standing landuse systems, recent decades have seen a marked intensification of pressures that exceed the buffering capacity of many habitats across Saudi Arabia. Contemporary national assessments estimate that around 70% of Saudi Arabia's rangelands are affected by desertification and are considered moderately to extremely degraded (Dawelbait, 2025). Long standing pressures include overgrazing, woodcutting, agricultural expansion and drought. Extensive field observations and previous studies consistently indicate that in common with other areas of Saudi Arabia, overgrazing by domestic livestock is the dominant contemporary driver of vegetation degradation in AlUla (Neale et al., 2023; Valhoriz, 2024).

Sustained grazing pressure drives a range of interrelated impacts, including reduced plant species diversity, a shift from palatable to unpalatable species, declines in vegetation cover, density, and biomass, and an increasing dominance of grazing resistant life forms (see Box 1 for information on plant indicators of grazing pressure). These changes are frequently associated

with disrupted vegetation dynamics, reduced seedling establishment, and soil degradation processes such as compaction and erosion (e.g. Assaeed, 2001; AlTaisan, 2022). Collectively, these changes can have cascading ecological effects, reducing habitat availability, shelter and food resources for wildlife, and contributing to declines in species dependent on structurally diverse native vegetation.

Woodcutting for fuel has traditionally been a significant driver of degradation with both direct effects on vegetation such as loss of woody vegetation, changes in species composition and reduced cover, as well as indirect effects including soil degradation. Woodcutting is now more driven by recreational camping use (Abuzinada, 2004).

Beyond overgrazing and woodcutting, other pressures such as off-road driving, agricultural practices and development also drive environmental degradation. Off-road driving causes damage to both the vegetation and to the soil surface. This is particularly significant in arid environments due to the slow rate of recovery of many native perennial plants meaning that even a single event can leave lasting damage (Assaeed et al., 2019). To address these pressures, the Royal Commission for AlUla has introduced measures prohibiting driving activities that damage vegetation cover. This policy is intended to reduce habitat degradation, support ecosystem recovery, and contribute to the long-term conservation of AlUla's natural landscapes (RCU, 2021). Historical and abandoned agricultural practices have further contributed to habitat degradation in some areas through soil disturbance, compaction, pollutants and increased salinity (Youssef et al., 2024; Maurice et al., 2024).

Climate change represents an additional long-term pressure on AlUla's ecosystems. Climate projections for the Arabian Peninsula indicate continued increases in temperature, alongside changes in rainfall patterns and the frequency and intensity of extreme weather events, including droughts and heavy rainfall episodes. These changes may interact with existing pressures by increasing water stress on vegetation, influencing species distributions, reducing ecosystem resilience, and altering erosion and flood dynamics. In arid environments, the effects of climate change are often difficult to separate from other drivers of degradation, but they are likely to influence the future condition, distribution and restoration potential of habitats across AlUla.

Recognising degradation in the field

The effects of degradation are often evident in the field through a range of visible indicators. Signs of overgrazing include reduced vegetation cover, a lack of recruitment, browsing damage to shrubs and trees, and the increasing dominance of unpalatable or grazing-resistant species. In woody habitats, mature trees may persist while younger age classes are absent, indicating long-term suppression of regeneration. Vehicle disturbance is typically expressed through the formation of informal tracks, damaged vegetation, disruption of soil surfaces, and localised erosion. Woodcutting may be recognised through reduced woody cover, the presence of cut stumps, and a simplified vegetation structure. Further information on plant species that may serve as indicators of grazing pressure and habitat degradation is provided in Box 1.

BOX 1 Plant indicators of grazing pressure

Certain plant species respond predictably to grazing pressure and can therefore be used as indicators of rangeland condition and condition trend. Species that decline under increasing grazing pressure are termed *decreasers*, whereas those that become more abundant are termed *increasers*. Monitoring changes in the relative abundance of these groups is widely recognised as an effective approach for assessing rangeland condition and ecological change.

Examples of decreaser species:
1 *Stipagrostis plumosa*
2 *Rhanterium epapposum*
3 *Calligonum comosum*
4 *Stipagrostis ciliata*

Decreasers are species that decline in abundance under increasing grazing pressure because they are generally palatable and selectively grazed by livestock. Their presence often indicates relatively good rangeland condition.

Examples of decreasers found in AlUla together with examples of references where their status as a decreaser is noted or discussed include:

Calligonum comosum (Barth, 1999; Mandaville, 1990). *Panicum turgidum* (Al-Taisan, 2022; Al-Rowaily et al., 2012. Mandaville, 1990; Batanouny, 1979) *Rhanterium epapposum* (Alzarah, 2020; Mandaville, 1990). *Stipagrostis* spp.: many species in the genus are important for grazing (Mandaville, 1990).


1


2


3


4



Increasers are species that tend to increase in abundance under heavy grazing pressure because they are less palatable, grazing tolerant, or better adapted to disturbed conditions. Their dominance may indicate declining rangeland condition.

Examples of increasers found in AlUla together with examples of references where their status as an increaser is noted or discussed include:

Asphodelus tenuifolius (Mandaville, 1990).

Calotropis procera: Mixed narrative on the palatability of this species. However, it is a sign of increasing pressure of man on environment (Miller and Morris, 1988). Livestock are said to avoid it, and it is often the only standing plant around villages where otherwise livestock would have eaten everything (Mandaville, 1990).

Citrullus colocynthis: Leaves unpalatable. Goats can eat immature fruit if there is very little else to feed on (Miller and Morris, 1988).





Rhazya stricta (Assaeed and Al-Doss, 2001).

Senna italica (Al-Sodany et al., 2020; Rowaily, 2015).

Tephrosia purpurea subsp. *apollinea*: Often abundant in overgrazed areas. Eaten only during dry season when animals are very hungry (Miller and Morris, 2004), widely considered an indicator of overgrazing (Miller and Morris, 2004; Jongbloed et al., 2003).

The response of individual species to grazing pressure can vary according to habitat type, rainfall patterns and local environmental conditions. Consequently, species should be interpreted alongside other indicators of habitat condition rather than in isolation.

Examples of increaser species:
1 *Calotropis procera*
2 *Rhazya stricta*
3 *Asphodelus tenuifolius*



DISCOVERING THE HABITATS OF ALULA

AlUla is a landscape of remarkable contrasts. Towering sandstone cliffs rise above broad sandy plains, volcanic plateaux overlook deep wadis, and rugged mountains create cooler refuges above the surrounding desert. The habitats found within this landscape support an unexpected diversity of plants and animals, many specially adapted to survive in one of the world's most challenging environments.

The habitats of AlUla have been shaped by the interaction of geology, climate, water and people over millions of years. Ancient volcanoes, shifting sands, intermittent floods and long histories of human land use have created a rich mosaic of environments, each supporting its own distinctive ecological communities.

ABOUT THIS FIELD GUIDE

This field guide has been developed as a practical introduction to the habitats of AlUla. Its primary purpose is to support habitat recognition and interpretation in the field by providing concise habitat descriptions, key identifying features, and summaries of the characteristic plants, animals, and environmental conditions associated with each habitat type.

The guide is intended for surveyors, biodiversity experts, conservation practitioners, land managers, researchers, and others working in AlUla's natural environments. It has been designed for use in the field and therefore focuses on information most relevant to habitat identification and understanding.

Habitat classification and mapping are complex processes that draw upon multiple sources of ecological information, including geology, soils, vegetation, flora, fauna, hydrology and spatial analysis. The habitat descriptions presented here are derived from the broader *Habitats of AlUla Technical Manual*, which provides detailed information on the development of the habitat classification, mapping methods, supporting datasets, habitat characterisation, and links to national and international ecosystem frameworks.

Users requiring more detailed ecological information, habitat maps, methodological explanations, species lists, or technical background should consult the full *Habitats of AlUla Technical Manual*. Together, the two documents provide complementary resources: this field guide supports practical habitat identification, while the technical manual provides the detailed scientific evidence and classification framework that underpin it.

WHAT IS A HABITAT?

A habitat is an area that provides a particular set of environmental conditions that support characteristic plants and animals. Habitats are defined not only by the species that occur within them, but also by the physical environment in which they occur. In AlUla, important factors include landform, geology, soils, water availability and vegetation.

For example, a volcanic plateau (harrat), a sandstone canyon, a sandy plain and a wadi may all support different plant and animal communities because they differ in their geology, topography, soils and hydrology. These recurring combinations of physical and biological characteristics allow habitats to be recognised, described and mapped.

In this guide, habitats are treated as practical units that can be recognised in the field. Habitat identification is based on a combination of:

- **Landform** (e.g. mountain, wadi, dune, plateau, cliff)
- **Substrate and geology** (e.g. basalt, sandstone, alluvium, sand)
- **Hydrology** (e.g. dry slope, drainage line, flooded depression)
- **Vegetation structure** (e.g. woodland, shrubland, grassland, sparsely vegetated ground)
- **Characteristic plants and animals**

Natural environments rarely occur as discrete units. Instead, habitats often grade gradually into one another along environmental gradients. A sandy plain may transition into a wadi, a dune system may merge into a sandstone landscape, or a volcanic slope may become increasingly rocky until it forms a cliff.

Because of this, habitat boundaries shown in maps should be regarded as useful interpretations of ecological patterns rather than precise lines on the ground. Surveyors should focus on identifying the dominant habitat present at a site and record uncertainty where transitions occur.

IDENTIFYING HABITATS IN THE FIELD

When identifying a habitat, it is often useful to start with the physical environment rather than the plant species present.

Ask yourself:

- What is the dominant landform?
- What type of rock, soil, or substrate is present?
- Is water an important influence on the site?
- What is the overall vegetation structure?
- Which habitat best matches the surrounding landscape context?

By considering these questions together, most sites can be assigned to a habitat consistently, even in areas where vegetation is sparse or habitat boundaries are gradual.

Habitats should be identified using multiple lines of evidence. While some habitats have characteristic plant species, identification should not rely on individual species alone. Landform, substrate, hydrology, vegetation structure and the wider landscape context should all be considered together.

HABITAT CONDITION

The habitats described in this guide are defined by relatively enduring environmental characteristics such as landform, geology, soils, and hydrology, together with their associated ecological communities. Although vegetation is important for habitat identification, habitats in AlUla have been modified to varying degrees by grazing, woodcutting, off-road driving, agricultural activities, and other human pressures. These processes can alter the appearance of a habitat without changing its underlying identity.

For example, a heavily grazed sandy plain may contain fewer shrubs and a different plant community than a less disturbed example of the same habitat. Similarly, a degraded wadi may have reduced vegetation cover or signs of erosion but still retain the characteristic landform, soils and hydrological setting that define it as a wadi habitat.

When identifying habitats in the field, surveyors should therefore focus on the underlying environmental setting rather than vegetation condition alone. Habitat type and habitat condition should be considered separately, and recorded independently where possible.

Recognising Signs of Degradation

Common indicators of habitat degradation in AlUla include:

- Reduced vegetation cover
- Lack of seedling recruitment
- Browsing damage to shrubs and trees
- Dominance of unpalatable or grazing-tolerant species
- Livestock tracks and dung
- Informal vehicle tracks and disturbed soil surfaces
- Evidence of erosion
- Cut stumps or loss of woody vegetation

These indicators can help assess the condition of a habitat but should not normally alter the habitat classification itself.



OVERVIEW OF ALULA HABITATS

HABITAT GROUPS AND HABITATS

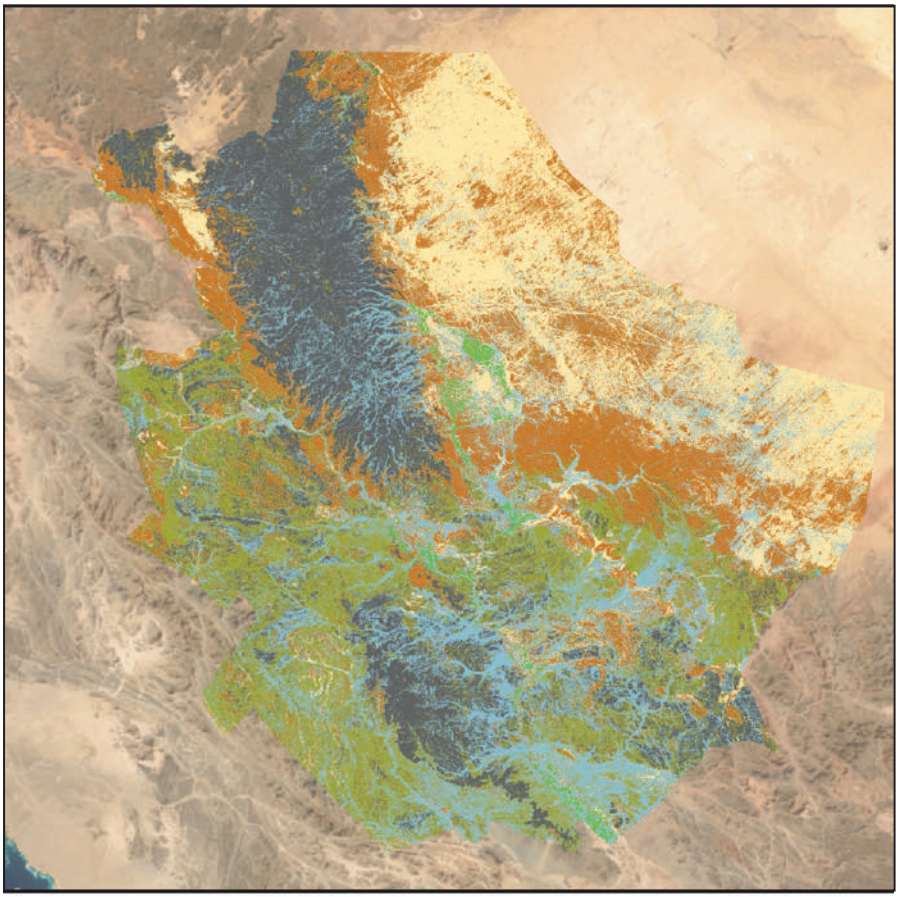
The AlUla Habitat Classification is organised as a simple hierarchy with two levels. At the broadest level are six Habitat Groups, representing the major landscapes of AlUla:

- Volcanics
- Sandstone landforms
- Sandy plains and dunes
- Mountains and associated plains
- Wadis and ephemeral wetlands
- Agricultural lands

Each habitat group is further divided into more detailed Habitats that capture finer differences in landform, substrate, hydrology, and ecological character. The table below summarises the hierarchical structure of the AlUla Habitat Classification, showing the relationship between habitat groups and the habitats they contain. Together with the associated Saudi Arabian National Ecosystem Types (Qurban, 2024).

KSA NATIONAL ECOSYSTEM TYPE	HABITAT GROUP	HABITAT
Northwestern Harrats	**1000** | Volcanics	**1100** | Harrat plateau and slopes **1200** | Harrat cliffs and steep slopes **1300** | Harrat drainage lines and wadis **1400** | Un-weathered lava flow **1500** | Volcanic cones **1600** | Ephemeral flooded depressions in volcanic craters
Northeast Hijaz Sandstone Plain and Plateaus	**2000** | Sandstone landforms	**2100** | Sandstone outcrops **2200** | Sandstone boulder slopes and screes **2300** | Sandstone canyons
Northeast Hijaz Sandstone Plain and Plateaus	**3000** | Sandy plains and dunes	**3100** | Sandy plains **3200** | Sand sheets with exposed bedrock **3300** | Sand dunes
Hijaz Mountain Summits and Hijaz Hills and Mountains	**4000** | Mountains and associated plains	**4100** | High-altitude mountains **4200** | Mid-altitude mountains **4300** | Low-altitude mountains **4400** | Gravel plains
Mixed	**5000** | Wadis and ephemeral flooded depressions	**5100** | Sandy wadis **5200** | Gravel wadis **5300** | Ephemeral flooded depressions
	6000 | Agricultural lands	**6100** | Agricultural lands

MAP OF ALULA'S HABITAT GROUPS



1000 Volcanics

2000 Sandstone landforms

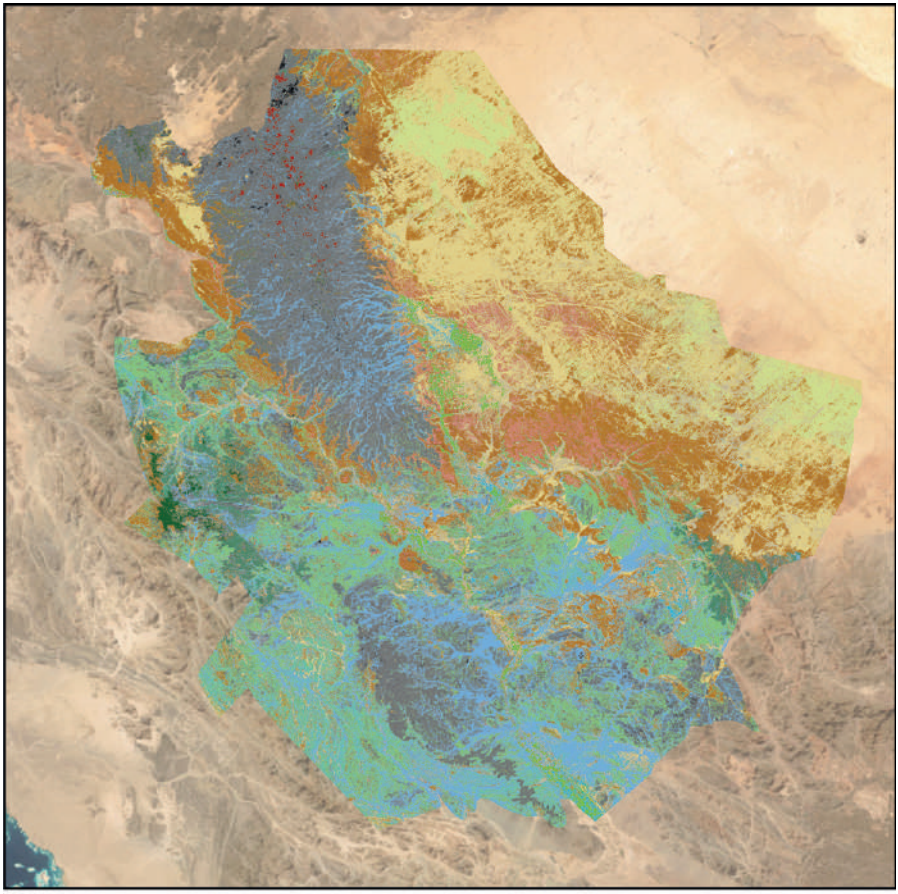
3000 Sandy plains and dunes

4000 Mountains and associated plains

5000 Wadis and ephemeral flooded depressions

6000 Agricultural lands

MAP OF ALULA'S HABITATS



- 1100 Harrat plateau and slopes
- 1200 Harrat cliffs and steep slopes
- 1300 Harrat drainage lines and wadis
- 1400 Un-weathered lava flow
- 1500 Volcanic cones
- 2100 Sandstone outcrops
- 2200 Sandstone boulder slopes and screes
- 2300 Sandstone canyons
- 3100 Sandy plains
- 3200 Sand sheets with bedrock
- 3300 Sand dunes
- 4100 High altitude mountains
- 4200 Mid altitude mountains
- 4300 Low altitude mountains
- 4400 Gravel plains
- 5100 Sandy wadis
- 5200 Gravel wadis
- 5300 Ephemeral flooded depressions
- 6100 Agricultural lands

HABITAT DECRIPTIONS

EXPLANATORY NOTES ON HABITAT DESCRIPTIONS

DESCRIPTION
Descriptive overview of the habitat.

GEOGRAPHIC AREA
Description and map of the distribution of this habitat type in AlUla.

GEOLOGY
Description of the habitat geology and an indication of the dominant bedrock.

SOILS
Description of the dominant soil type in the habitat.

VEGETATION
Description of the structure of the vegetation and the dominant species, together with an indication of the variation in the vegetation found within the habitat. Intended as a practical tool for the field.

FLORA
Characteristic flora

Species that are regularly and predictably found within the habitat. This includes species that are dominant or very frequently seen in the habitat and those that might be uncommon but show a strong association with the habitat based on field data and literature. Very widespread generalists are avoided where they are not dominant or extremely common in a habitat, as they contribute little to defining the habitat's ecological identity.

High conservation value flora

A list of species identified as being of high conservation significance, based on national endemism, restricted range and rarity or their threatened status on the IUCN Red List (CR, EN, VU).

FAUNA

Characteristic fauna

Same as for plant species, animal species will be considered if they are regularly found in the habitat. Some species may occur in multiple habitats, but they should be listed according to how representative they are of the specific habitat. Very widespread generalists should be avoided for the same reasons already mentioned for plant species.

High conservation value fauna

List of fauna species selected based on endemism to the Arabian Peninsula, threatened status (CR, EN, VU) under IUCN Red List criteria at a regional scale, and restricted geographic range.

DEGRADATION

The drivers of degradation recorded in the field or known from other studies in the area are recorded here.

RELATED HABITATS

Habitats that commonly occur in association with, transition into, or may be confused with the focal habitat. This section provides guidance on ecological relationships and key features that help distinguish similar habitat types in the field and during mapping.



1000 | VOLCANICS

1100 | HARRAT PLATEAU AND SLOPES

1200 | HARRAT CLIFFS AND STEEP SLOPES

1300 | HARRAT DRAINAGE LINES AND WADIS

1400 | UN-WEATHERED LAVA FLOW

1500 | VOLCANIC CONES

1600 | EPHEMERAL FLOODED DEPRESSIONS IN VOLCANIC CRATERS

1000 | VOLCANICS

OUTLINE

The Volcanics habitats encompass the range of landforms associated with the volcanic features of AlUla. These harrat systems form some of the largest continuous volcanic fields in Arabia and define much of the regional landscape character. Their varied topography and generally higher elevations create in places cooler, more sheltered microenvironments that act as important refugia for specialised plant and animal communities.

ASSOCIATED KSA NATIONAL ECOSYSTEM TYPES

Northwestern Harrats.

HABITATS

- **1100** | HARRAT PLATEAU AND SLOPES
- **1200** | HARRAT CLIFFS AND STEEP SLOPES
- **1300** | HARRAT DRAINAGE LINES AND WADIS
- **1400** | UN-WEATHERED LAVA FLOW
- **1500** | VOLCANIC CONES
- **1600** | EPHEMERAL FLOODED DEPRESSIONS IN VOLCANIC CRATERS



Figure 6 | Distribution of the Volcanic habitat group (1000) in AlUla county.









1100 | HARRAT PLATEAU AND SLOPES

DESCRIPTION

The Harrat plateau and slopes habitat comprises broad volcanic uplands and gentle sloping terrain formed from extensively weathered basaltic lava flows. Over time, these flows have broken down into a complex mosaic of rough, rubbly pavements, often interspersed with shallow depressions and pockets of finer sediments. The terrain is characteristically dark, rocky, and uneven, shaped by repeated volcanic episodes and long-term physical weathering.

GEOGRAPHIC AREA

Harrat plateau and slopes habitat is found on Harrat Uwayrid and Harrat AlZabin.

GEOLOGY

The substrate is dominated by several mafic lava types. Basalt dominates with fine grained minerals, but this habitat can also include picrite (high olivine content), ankaramite (pyroxene rich), vesicular basalt, and in some areas close to volcanoes, scoria boulders and gravels can be found. The different types of basalts erode differently and create different types of habitats.

SOILS

The soils are predominantly loamy and derived from the weathering of basaltic parent material. Surface layers are typically stony, with abundant basalt rocks and gravels resulting from past volcanic activity. Wind-blown sand accumulates in depressions and sheltered locations, forming localised pockets of finer sediment across the harrat landscape.



1



2



3



4

VEGETATION

Absent or very sparse degraded dwarf shrubland typically dominated by *Fagonia bruguieri* and *Morettia parviflora*.

Vegetation is restricted to sandy pockets between rocks and in distinctive shallow depressions where an annual flush forms.

FLORA

Characteristic flora

Perennials

- *Anvillea garcinii*
- *Diplotaxis harra*
- *Fagonia bruguieri*
- *Helianthemum lippii*
- *Morettia parviflora*

Annual species

- *Anastatica hierochuntica*
- *Asphodelus tenuifolius*
- *Bromus tectorum*
- *Centaurea sinaica*
- *Leysera leyseroides*
- *Pallenis hierochuntica*
- *Plantago afra*
- *Plantago ovata*
- *Senecio flavus*
- *Stipellula capensis*
- *Trigonella stellata*
- *Zoegea purpurea*

High conservation value flora

- *Ferula sinaica*

FAUNA

Characteristic fauna

- *Alectoris chukar* (Chukar)
- *Gerbillus dasyurus* (Wagner's gerbil)
- *Phoenicurus ochruros* (Black Redstart)
- *Steatoda cf. paykulliana* (False widow spider)
- *Thanatus cf. setiger* (False crab spider)

High conservation value fauna

- *Agrotis ipsilon*
- *Canis lupus* (Grey wolf)
- *Capra nubiana* (Nubian ibex)
- *Hyles livornica*

DEGRADATION

The major driver of degradation in this habitat is overgrazing. Off-road driving also has a significant impact in some areas.

RELATED HABITATS

None

1 *Alectoris chukar* (Chukar)
2 *Morettia parviflora*
3 *Pallenis hierochuntica*
4 *Anastatica hierochuntica*







1200 | HARRAT CLIFFS AND STEEP SLOPES

DESCRIPTION

Steep rocky boulder strewn slopes and cliffs of the higher altitude harrat.

These areas are characterised by sharp relief, exposed rock faces, and accumulations of angular basalt blocks derived from collapse and erosion of cliff edges. Slopes range from nearvertical rock faces to steep rocky slopes. In places the basalt boulders are mixed with boulders from the underlying sandstone. The smooth basaltic rock faces on small cliffs create refugia in these habitats for a number of range restricted plant species only found in the NW of the country such as *Roemeria hybrida*, *Ballota undulata* and *Echinops glaberrimus*.

GEOGRAPHIC AREA

These are found in all the harrat areas.

GEOLOGY

Similar to Harrat plateau and slopes (1100), the dominant rock is basalt. These are boulders of varying sizes, ranging from angular to sub-angular in shape with gaps providing space for animals and plants.

SOILS

Located in the steep stony slopes, these shallow soils are found in micro-depressions and flat areas between rocks. The sloping position of these soils makes them susceptible to erosion by run-off.



VEGETATION

Open mixed dwarf shrubland.

Typically dominated by species such as *Helianthemum lippii and Cymbopogon schoenanthus* with *Diplotaxis harra.*

FLORA

Characteristic flora

Perennials

- *Agathophora alopecuroides*
- *Artemisia sieberi*
- *Ballota undulata*
- *Caroxylon villosum*
- *Cymbopogon schoenanthus*
- *Diplotaxis harra*
- *Echinops glaberrimus*
- *Ephedra ciliata*
- *Fagonia mollis*
- *Helianthemum lippii*
- *Morettia parviflora*

1 *Artemisia sieberi*
2 *Cuprella homalocarpa*


2

Annuals

- *Bromus scoparius*
- *Bromus tectorum* subsp. *lucidus*
- *Cuprella homalocarpa*
- *Roemeria hybrida*
- *Rumex vesicarius*
- *Senecio flavus*
- *Stipellula capensis*

High conservation value flora

- *Ducrosia flabellifolia*
- *Hyocyamus viscosus*

FAUNA

Characteristic fauna

- *Euchloe belemia* (Green-striped white)
- *Tropiocolotes yomtovi* (Yom-Tov's sand gecko)

High conservation value fauna

- None

DEGRADATION

The major driver of degradation on this habitat is overgrazing.

RELATED HABITATS

1500 | VOLCANIC CONES. It can be difficult to distinguish these two habitats in the field, particularly where volcanic cones are highly eroded.









1300 | HARRAT DRAINAGE LINES AND WADIS

DESCRIPTION

Harrat drainage lines and wadis comprise the network of narrow channels and upper wadi systems that dissect volcanic plateaus and slopes within the harrat.

Drainage lines range from small, rocklined runnels with sparse vegetation to broader channels forming well-defined upper wadis, where deeper soils and more continuous plant cover develop. Together, they form linear features that link the volcanic uplands with downslope wadi systems, occupying a transitional position within the broader harrat landscape mosaic.

GEOGRAPHIC AREA

Found in all of the harrat areas.

GEOLOGY

Dominant rock is basalt, in the form of sub-rounded to rounded boulders. Mixed with the basalt is finer gravel and wind-blown sands that have been transported through the wadi systems.

SOILS

Stony alluvial soil in the wadis of the harrat plateau. It originates from strong erosion-deposition processes driven by water, capable of transporting rock fragments and breaking them down to stones. Plants growing in these soils benefit from drained water but may occasionally be subjected to these erosive factors.





VEGETATION

Open mixed dwarf shrubland developing into a sparse woodland in larger channels.

Typically dominated by species such as *Retama raetam*, *Lycium shawii*, *Anvillea garcinii*, *Helianthemum lippii, Ephedra ciliata* and *Cymbopogon schoenanthus.* Forming a very open *Vachellia* woodland in larger wadis, primarily *Vachellia gerrardi* var. *najdensis* on Harrat Uwayrid with *Vachellia oerfota* on Harrat AlZabin.

FLORA

Characteristic flora

Perennials

- *Anvillea garcinii*
- *Artemisia sieberi*
- *Astragalus spinosus*
- *Centaurea ammocyanus*
- *Cymbopogon schoenanthus*
- *Ephedra ciliata*
- *Fagonia bruguieri*
- *Fagonia mollis*
- *Helianthemum lippii*
- *Lycium shawii*
- *Ochradenus baccatus*
- *Retama raetam*
- *Vachellia gerrardi* var. *najdensis*
- *Vachellia oerfota*
- *Vachellia tortilis* subsp. *raddiana*
- *Zilla spinosa*

1 *Anvillea garcinii*
2 *Scorpio fuscus* (Dark large-clawed scorpion)
3 *Platyceps saharicus* (Saharan racer)


3

Annuals

- *Asphodelus fistulosus*
- *Asphodelus tenuifolius*
- *Plantago amplexicaulis*
- *Stipellula capensis*
- *Trigonella stellata*
- *Zoegea purpurea*

High conservation value flora

- *Astragalus echinus*
- *Ducrosia flabellifolia*
- *Ferula sinaica*
- *Pulicaria guestii*

FAUNA

Characteristic fauna

- *Agrotis segetum*
- *Casama innotata*
- *Chalcides ocellatus* (Ocellated bronze skink)
- *Curruca leucomelaena* (Arabian Warbler)
- *Gerbillus dasyurus* (Wagner's gerbil)
- *Scorpio fuscus* (Dark large-clawed scorpion)
- *Selenops radiatus* (Palm wall crab spider)
- *Streblote acaciae*

High conservation value fauna

- *Agrotis ipsilon*
- *Buteo rufinus*
- *Caprimulgus nubicus*
- *Junonia orithya* (Blue pansy)
- *Pandesma robusta*
- *Platyceps saharicus* (Saharan racer)

DEGRADATION

The major driver of degradation on this habitat is overgrazing.







1400 | UN-WEATHERED LAVA FLOW

DESCRIPTION

Un-weathered lava flows consisting of relatively fresh basaltic surfaces where original volcanic textures remain clearly expressed. Distinct features such as a'a lava are visible, forming sharp, blocky surfaces or the smooth, ropy pahoehoe lava forms with minimal breakdown. These flows are structurally young, with limited soil development and high surface roughness, creating an environment dominated by exposed basalt and angular lava blocks. Despite being relatively young, the lava contains lots of cracks as the surface crust is separated by air. There are numerous pyroducts varying from 1 meter to several meters in length, creating areas of refugia for small mammals and reptiles.

GEOGRAPHIC AREA

This habitat is well represented in other areas such as the Harrat Khaybar White Volcano Geopark south of AlUla, where the observations used to characterise and define the habitat were recorded. Images shown here are from Khaybar. Remote sensing analyses suggest that similar un-weathered lava flows may also occur in limited areas of the northern part of Harrat Uwayrid. However, these occurrences have not yet been verified through targeted field survey and should therefore be regarded as provisional.



GEOLOGY

The un-weathered lava flows are composed from basalt. These lava flows have varying surface types. Smooth pahoehoe lava, has a ropey type texture, whereby the surface is a relatively thin crust creating several areas of collapses which can be inhabited by small mammals and reptiles. Pyroducts, such as lava tubes can also be found under pahoehoe lava, where collapses have opened them up. A'a lava is the second main type of lava, which consists of sharp, angular, slabs.

SOILS

In the micro-depression of the lava geologic formations, fine particles have been deposited over time with winds and water, forming very shallow soil accumulation, silt-clay which in turn allows the germination of the few seeds.

VEGETATION

Vegetation is extremely sparse and confined to small pockets where sand and soil accumulate in fractures, or between lava blocks.





FLORA

Characteristic flora

- *Achillea fragrantissima*
- *Artemisia judaica*
- *Pulicaria undulata*
- *Schouwia purpurea*
- *Scrophularia deserti*

High conservation value flora

- *Artemisia judaica*

FAUNA

Characteristic fauna

- *Zelotes sp.* (Ground spider)

High conservation value fauna

- *Calandrella eremica* (Rufous-capped Lark)

DEGRADATION

This habitat is relatively protected from degradation due to its inaccessibility.

RELATED HABITATS

The presence of this habitat in AlUla county needs to be further verified by on the ground assessments

1 *Pulicaria undulata*



1500 | VOLCANIC CONES

DESCRIPTION

Volcanic cones form steep, well-defined landforms built around central vents, with slopes composed of loose scoria, ash, and fragmented weathered basalt. These cones transition from highly exposed upper slopes to more sheltered lower flanks, creating strong microtopographic and microclimatic gradients. In the AlUla harrat system, they occur as a spectrum of forms, from well preserved cinder cones with intact crater rims, to highly eroded remnants where only degraded flanks or partial ridges remain.

GEOGRAPHIC AREA

Found in all harrat areas.

GEOLOGY

The geology depends upon the volcano type. In AlUla, the geology is basalt and scoria. The state of the volcano depends upon its age. Older volcanoes are much more weathered, losing the classic ‘volcano shape’, whereas younger volcanoes will maintain the slopes and crater.

SOILS

These soils come from volcanic and colluvial deposits. They are located on the slopes of volcanic reliefs which by erosion and deposition form these accumulations soils. These soils are potentially rich in mineral elements.



VEGETATION

The vegetation is usually composed of species such as *Artemisia judaica*, *Gypsophila capillaris, Noaea mucronata* and *Ducrosia flabellifolia*.

FLORA

Characteristic flora

- *Artemisia judaica*
- *Ducrosia flabellifolia*
- *Gypsophila capillaris*
- *Noaea mucronata*

High conservation value flora

- *Ducrosia flabellifolia*

FAUNA

Characteristic fauna

- *Freyeria trochilus* (Grass jewel)
- *Scorpio fuscus* (Dark large-clawed scorpion)
- *Tropiocolotes yomtovi* (Yom-Tov's sand gecko)

High conservation value fauna

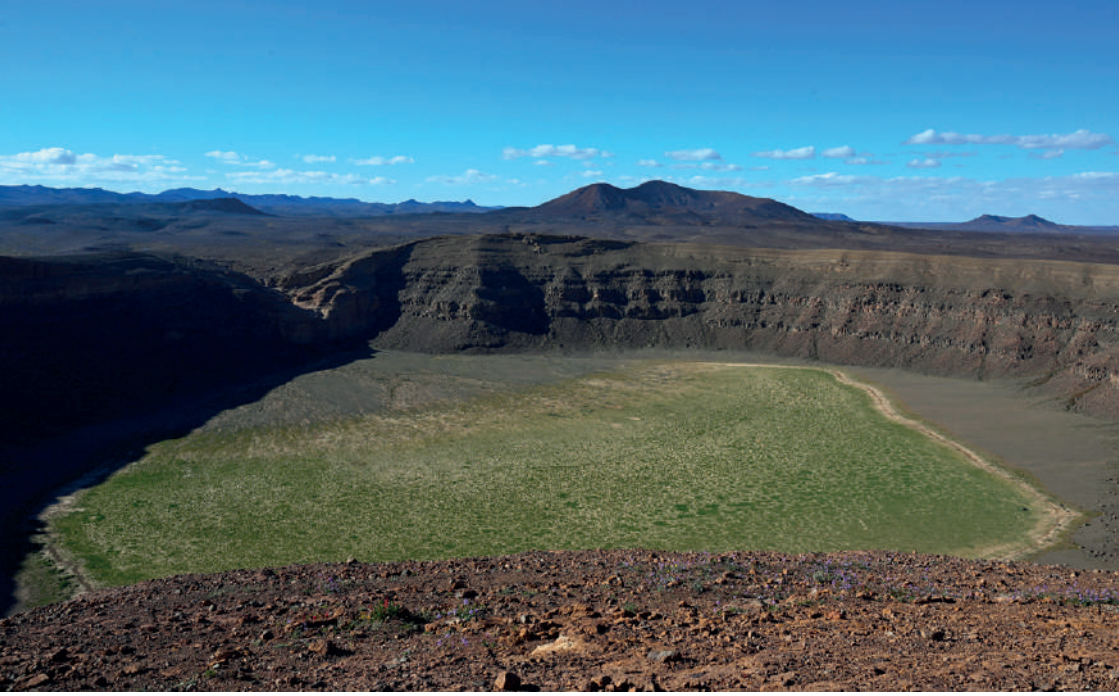
- *Junonia orithya* (Blue pansy)

DEGRADATION

Overgrazing.

RELATED HABITATS

1200 | HARRAT CLIFFS AND STEEP SLOPES. It can be difficult to distinguish these two habitats in the field, particularly where volcanic cones are highly eroded.



1600 | EPHEMERAL FLOODED DEPRESSIONS IN VOLCANIC CRATERS

DESCRIPTION

Bowl shaped depression within a volcanic cone.

GEOGRAPHIC AREA

These are found within some of the volcanic cones in the harrat areas of AlUla.

GEOLOGY

Basaltic volcanic bedrock (basalt lava flows and scoria deposits). Within the crater, weathered scoria often dominates the surface substrate.

SOILS

Ephemerally flooded microsites occur within flat depression basins. Soils are highly compacted and characterised by high silt and clay content, resulting in low permeability. Some areas also exhibit salt crust formation. Temporary flooding occurs following heavy rainfall events. Together, these factors create an extremely challenging environment characterised by harsh edaphic and microclimatic conditions.





VEGETATION

Vegetation in this unique habitat typically includes *Ducrosia flabellifolia, Noaea mucronata, Gypsophila capillaris, Helianthemum lippii, Farsetia aegyptia, Ballota undulata, Salvia deserti, Diplotaxis acris* and *Artemisia judaica*.

FLORA

Characteristic flora

- *Artemisia judaica*
- *Ballota undulata*
- *Ducrosia flabellifolia*
- *Farsetia aegyptia*
- *Gypsophila capillaris*
- *Helianthemum lippii*
- *Noaea mucronata*
- *Salvia deserti*

High conservation value flora

- *Ducrosia flabellifolia*

FAUNA

Characteristic fauna

- *Acanthodactylus boskianus* (Bosk's fringe-fingered lizard)
- *Stenodactylus doriae* (Dune sand gecko)

High conservation value fauna

- None

DEGRADATION

The craters are relatively well protected from the impact of grazing and off-road driving.

RELATED HABITATS

5300 | EPHEMERAL FLOODED DEPRESSIONS. These two habitats are functionally similar however these are enclosed within volcanic landforms, whereas 5300 occur across a broader landscape context, typically within wadi systems, plains, or low-lying areas.

1 *Salvia deserti*



2000 | SANDSTONE LANDFORMS

2100 | SANDSTONE OUTCROPS

2200 | SANDSTONE BOULDER SLOPES AND SCREES

2300 | SANDSTONE CANYONS

2000 | SANDSTONE LANDFORMS

OUTLINE

Sandstone landforms comprise extensive sandstone plateaus, inselbergs, buttes, mesas, cliffs, and associated slopes that dominate large parts of eastern and northeastern AlUla. These landscapes are defined by exposed sandstone bedrock shaped by longterm erosion, resulting in a strongly dissected terrain of high relief and distinctive rock forms.

In central AlUla, the dominant bedrock is the Siq Sandstone, which is very well cemented, red due to high iron content, and heavily fractured. These are hard blocky sandstones creating large ridges, or mesa. In central AlUla and moving towards the north, the lighter, Quweria Sandstone is exposed creating a mixture of sandstone formations and sandy plains and dunes. The Saq Sandstone lies to the north and north east, with hard iron beds exposed, interspaced with pebble gravel plains and accumulations of fine sandy plains.

Sandstone landforms provide the physical framework for a range of associated habitats, including outcrops, boulder slopes, screes, and canyons. Shallow soils and variable exposure lead to patchy vegetation cover, while shaded cliffs, ledges, and sheltered slopes form important refugia for specialised and locally restricted species. Collectively, these landforms constitute a key structural component of the AlUla landscape, contributing strongly to its ecological diversity, visual character, and natural and cultural heritage.

ASSOCIATED KSA NATIONAL ECOSYSTEM TYPES

Northeast Hijaz Sandstone Plain and Plateaus.

HABITATS

- **2100** | SANDSTONE OUTCROPS
- **2200** | SANDSTONE BOULDER SLOPES AND SCREES
- **2300** | SANDSTONE CANYONS

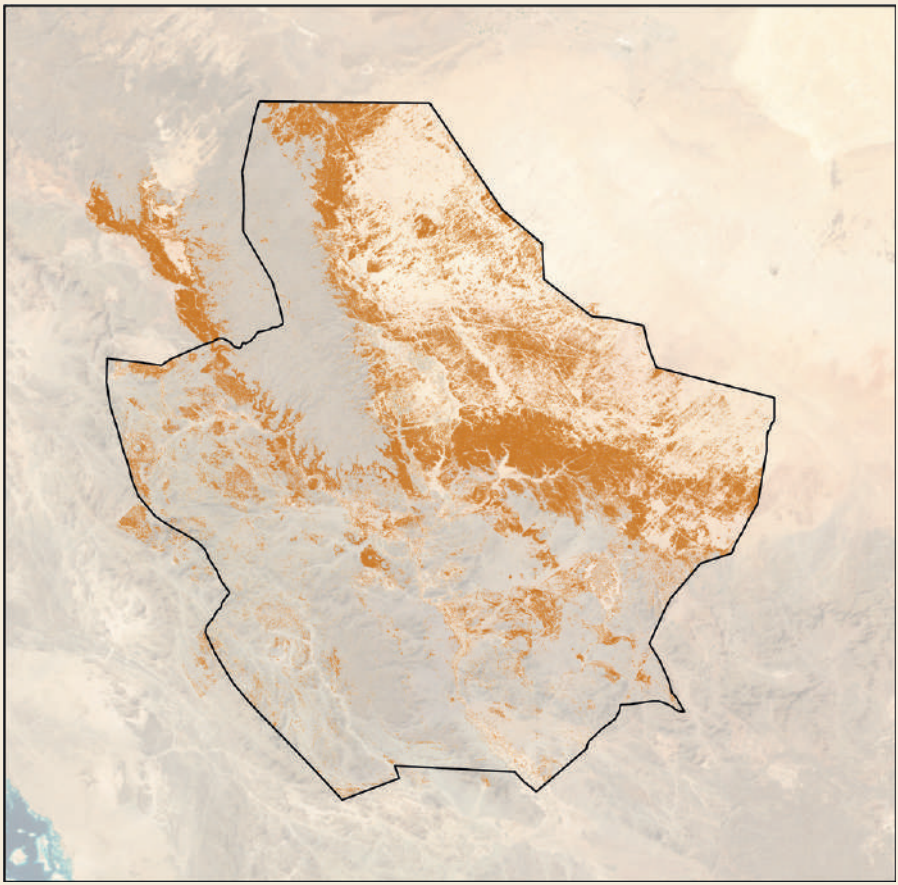
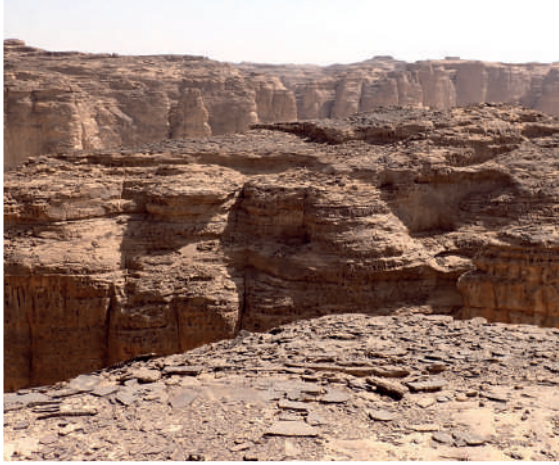


Figure 7 | Distribution of the Sandstone Landform habitat group (2000) in AlUla County.











2100 | SANDSTONE OUTCROPS

DESCRIPTION

Sandstone bedrock and loose shale and gravel pavements of the summits of inselbergs, buttes, mesa, and sandstone hills.

GEOGRAPHIC AREA

Central, North East and East of AlUla.

GEOLOGY

In central AlUla, the Siq Sandstone, which is very well cemented, red due to high iron content, creates large flat-topped ridges (mesas). Moving towards the north, aeolian weathering of the softer Quweria Sandstone and Saq Sandstone create a variety of landforms dominated by tafoni features on the exposed surfaces.



1



2

SOILS

Soils develop as very shallow accumulations within small pockets, fissures, and depressions on eroded sandstone surfaces. Their formation results from the combined effects of sandstone weathering and the deposition of wind- and water-transported fine particles, allowing limited pedogenesis in an otherwise exposed and rocky environment.

VEGETATION

Bare rock or sparse mixed perennial herb community.

Plants are concentrated along runnels and in cracks on the summits of buttes and sandstone hills. Typically dominated by a dwarf shrubland of *Fagonia bruguieri*, *Helianthemum lippii, Gymnocarpos decander* and *Anvillea garcinii.*

FLORA

Characteristic flora

Perennials

- *Anvillea garcinii*
- *Ephedra ciliata*
- *Fagonia bruguieri*
- *Farsetia aegyptia*
- *Gymnocarpos decander*
- *Haloxylon salicornicum*
- *Helianthemum lippii*
- *Soda schweinfurthii*
- *Stipagrostis ciliata*

Annuals

- *Asphodelus tenuifolius*
- *Diplotaxis acris*
- *Leysera leyseroides*
- *Picris* spp.
- *Plantago amplexicaulis*
- *Plantago ciliata*
- *Rumex vesicarius*
- *Savignya parviflora*
- *Schismus barbatus*
- *Senecio flavus*
- *Stipellula capensis*


3

High conservation value flora

- *Pterocephalus sanctus*
- *Ramaliella intricata*

FAUNA

Characteristic fauna

- *Artema nephilit* (Giant daddy-long-leg spider)
- *Buthacus yotvatensis* (Yotvata sand scorpion)
- *Coturnix coturnix* (Common Quail)
- *Curruca nana* (Asian Desert Warbler)
- *Eremalauda eremodites* (Arabian Lark)
- *Oenanthe oenanthe* (Northern Wheatear)
- *Psammophis schokari* (Schokari sand racer)
- *Pseudotrapelus sinaitus* (Sinai agama)
- *Ptyodactylus ananjevae* (Ananjeva's fan-fingered gecko)
- *Uroctea cf. thaleri* (Bordered disc web spider)

High conservation value fauna

- *Ammomanes cinctura* (Bar-tailed Lark)
- *Circus aeruginosus* (Western Marsh-harrier)

DEGRADATION

Primary degrader is overgrazing.

RELATED HABITATS

2200 | SANDSTONE BOULDER SLOPES AND SCREES. These two habitats are closely related and commonly occur together as part of the same sandstone landform systems.

1 *Gymnocarpus decander*
2 *Helianthemum lippii*
3 *Buthacus yotvatensis* (Yotvata sand scorpion)











2200 | SANDSTONE BOULDER SLOPES AND SCREES

DESCRIPTION

Sandstone boulder slopes and screes are erosion dominated landforms that form on or below sandstone outcrops. These slopes are shaped by the breakdown and collapse of sandstone boulders, producing accumulations of coarse debris. Large boulders and irregular sandstone fragments create a mosaic of shaded pockets, sheltered voids, and small microterraces that retain moisture and fine sediments.

GEOGRAPHIC AREA

Scattered across the sandstone areas of AlUla.

GEOLOGY

In central AlUla, the dominant bedrock is the Siq Sandstone, which is very well cemented, red due to high iron content, and heavily fractured. Northwards, the geology is dominated by the Quweria Sandstone and the Saq Sandstone.

SOILS

This soil originates from intense mechanical weathering of sandstone combined with gravity-driven erosion processes, producing coarse sand, gravel, and angular rock fragments that accumulate on scree slopes and at the base of cliffs. These soils are shallow and weakly developed, reflecting limited pedogenic processes under hyper-arid climatic conditions.



VEGETATION

Very sparse mixed dwarf shrub vegetation.

Commonly with the shrub *Ephedra ciliata* and dwarf shrubs *Anvillea garcinii*, *Iphiona scabra, Helianthemum lippii* and *Farsetia spp*. In places this develops into a very open woodland dominated by scattered trees of *Vachellia tortilis* subsp. *tortilis* and *Vachellia tortilis* subsp. *raddiana* and the tussock grass *Panicum turgidum* becoming transitional with sandy wadis and plains.

FLORA

Characteristic flora

Perennials

- *Anvillea garcinii*
- *Ephedra ciliata*
- *Farsetia burtonae*
- *Farsetia longisiliqua*
- *Haloxylon salicornicum*
- *Helianthemum lippii*
- *Iphiona scabra*
- *Ochradenus baccatus*

High conservation value flora

- None

1 *Ephedra ciliata*
2 *Farsetia burtonae*



2

FAUNA

Characteristic fauna

- *Artema nephilit* (Giant daddy-long-leg spider)
- *Buthacus yotvatensis* (Yotvata sand scorpion)
- *Curruca nana* (Asian Desert Warbler)
- *Eremalauda eremodites* (Arabian Lark)
- *Gerbillus dasyurus* (Wagner's gerbil)
- *Monticola solitarius* (Blue Rock-thrush)
- *Oenanthe oenanthe* (Northern Wheatear)
- *Plecotus christii* (Christie's big-eared bat)
- *Psammophis schokari* (Schokari sand racer)
- *Pseudotrapelus sinaitus* (Sinai agama)
- *Ptyodactylus ananjevae* (Ananjeva's fan-fingered gecko)
- *Uroctea cf. thaleri* (Bordered disc web spider)

High conservation value fauna

- *Ammomanes cinctura* (Bar-tailed Lark)
- *Bubo ascalaphus* (Pharaoh Eagle-owl)
- *Canis lupus* (Grey wolf)
- *Circus aeruginosus* (Western Marsh-harrier)
- *Curruca melanocephala* (Sardinian Warbler)

DEGRADATION

Grazing present.

RELATED HABITATS

- **3100** | SANDY PLAINS and **5100** | SANDY WADIS. In places the vegetation may develop into a very open woodland dominated by scattered *Vachellia tortilis* subsp. *tortilis* and *V. tortilis* subsp. *raddiana*, with *Panicum turgidum*, becoming transitional to these habitats.
- **2100** | SANDSTONE OUTCROPS. These two habitats are closely related and commonly occur together as part of the same sandstone landform systems.













2300 | SANDSTONE CANYONS

DESCRIPTION

Sandstone canyons are deeply incised, narrow wadi systems cut into sandstone landforms. They are characterised by steep to nearvertical rock walls, confined valley floors, and strong contrasts between exposed, sunlit slopes and shaded, sheltered canyon interiors.

Also included here are sandstone gullies which represent smaller scale incisions that dissect sandstone slopes and canyon walls. These share many structural and ecological characteristics but lack extensive canyon floors or developed riparian vegetation.

GEOLOGY

The dominant geology is the Quweria and Saq sandstones.

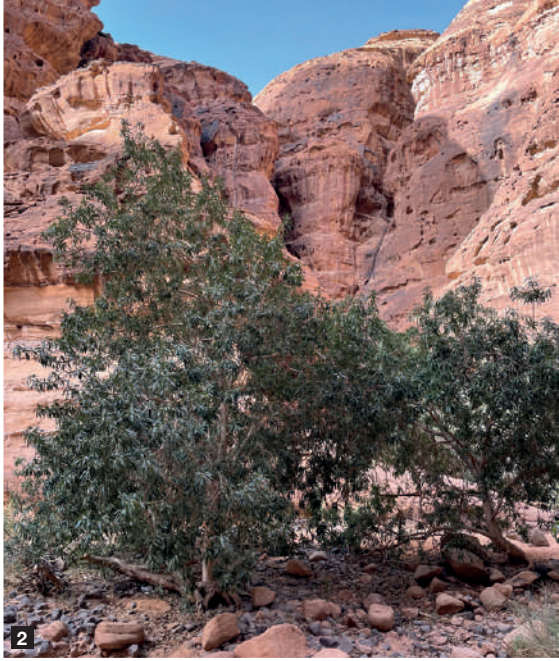
GEOGRAPHIC AREA

Sandstone landscapes of eastern and northeastern AlUla.

SOILS

These soils formed from fluvial deposits shaped by erosion and sedimentation. Located downstream of rocky and unstable slopes, their stony texture reflects the energy and turbulence of past floods, while visible stratification reveals changes in flow velocity during deposition.


1


2


3


4


5

VEGETATION

Typically dominated by species such as *Retama raetam* and *Ochradenus baccatus* and *Vachellia gerrardi* var. *najdensis* with *Ficus* spp. in wetter areas.

FLORA

Characteristic flora

- *Abutilon bidentatum*
- *Anvillea garcinii*
- *Citrullus colocynthis*
- *Dodonaea viscosa*
- *Farsetia aegyptia*
- *Ficus palmata*
- *Ficus salicifolia*
- *Heliotropium ramosissimum*
- *Hyoscyamus pseudoalbus*
- *Lavandula coronopifolia*
- *Lavandula pubescens*
- *Lycium shawii*
- *Nanorrhinum acerbianum*
- *Ochradenus baccatus*
- *Panicum turgidum*
- *Periploca aphylla*
- *Phagnalon sinaicum*
- *Retama raetam*
- *Vachellia gerrardi*
- *Vachellia tortilis* subsp. *raddiana*
- *Withania somnifera*

High conservation value flora

- *Hyoscyamus pseudoalbus*

FAUNA

Characteristic fauna

- *Agrotis segetum*
- *Buthacus yotvatensis* (Yotvata sand scorpion)
- *Cerastes gasperettii* (Gasperetti's viper)
- *Drasteria flexuosa*
- *Felis lybica* (Afro-Asiatic wildcat)
- *Plecotus christii* (Christie's big-eared bat)
- *Ptyodactylus ananjevae* (Ananjeva's fan-fingered gecko)
- *Rhinopoma cystops* (Arabian Mouse-tailed bat)
- *Spalerosophis diadema* (Diadem snake)
- *Streblote acaciae*
- *Thanatus cf. setiger* (False crab spider)
- *Uromastyx aegyptia* (Egyptian mastigure)
- *Zamarada minimaria*

High conservation value fauna

- *Agrotis ipsilon*
- *Apus apus (*Common Swift)
- *Bubo ascalaphus* (Pharaoh Eagle-owl)
- *Canis lupus* (Grey wolf)
- *Capra nubiana* (Nubian ibex)
- *Falco concolor* (Sooty Falcon)
- *Falco peregrinus (*Peregrine Falcon/Barbary Falcon)
- *Hyles livornica*
- *Pandesma robusta*
- *Platyceps saharicus* (Saharan racer)

DEGRADATION

Overgrazing and off-road driving both impact sandstone canyons.

RELATED HABITATS

5100 | SANDY WADIS and **3100** | SANDY PLAINS. Canyons have steep rock walls and are narrow relative to the wall height. Wadis are less confined fluvial systems; where associated with sandstone relief, valley width exceeds the height of the surrounding walls. This relationship should be interpreted at the landscape scale, as local widening or narrowing within a system may not reflect the dominant landform.

1 *Phagnalon sinaicum*
2 *Ficus cordata* var *salicifolia*
3 *Cerastes gasperettii* (Gasperetti's viper)
4 *Dodonaea viscosa*
5 *Bubo ascalaphus* (Pharaoh Eagle-owl)



3000 | SANDY PLAINS AND DUNES

3100 | SANDY PLAINS

3200 | SAND SHEETS WITH EXPOSED BEDROCK

3300 | SAND DUNES

3000 | SANDY PLAINS AND DUNES

OUTLINE

The sandy plains and dunes habitats encompasses the extensive sand dominated landscapes of eastern AlUla, along with smaller patches distributed across the wider county. These deposits originate from a mix of geomorphological processes and long-distance aeolian transport. Surface stability varies widely: sandy plains typically form gently undulating, semi-stable terrain, while deeper accumulations develop where sand becomes trapped against natural barriers such as sandstone buttes, wadi margins, or topographic features.

Vegetation structure reflects this variability. Sandy plains commonly support open dwarf shrubland dominated by drought-tolerant shrubs and grasses, while deeper or more mobile sands support more specialised dune vegetation, including open shrubland and, in some areas, very open *Haloxylon persicum* woodland. These habitat forms a key ecological matrix linking sandstone landforms, wadis, and gravel plains, supporting flora and fauna characteristic of sandy desert systems.

ASSOCIATED KSA NATIONAL ECOSYSTEM TYPES

Northeast Hijaz Sandstone Plain and Plateaus.

HABITATS

- **3100** | SANDY PLAINS
- **3200** | SAND SHEETS WITH EXPOSED BEDROCK
- **3300** | SAND DUNES



Figure 8 | Distribution of Sandy plains and dunes habitat group (3000) in AlUla County.



3100 | SANDY PLAINS

DESCRIPTION

Sandy plains are open, low-relief landscapes dominated by sand-rich substrates. They range from extensive areas of almost pure sand to mixed sandy-gravel plains where sand remains the dominant surface material. The substrate is typically composed of fine, well-sorted sand, although larger rounded pebbles may occur locally.

GEOGRAPHIC AREA

Most widespread in the east of AlUla associated with the sandstone landforms. Also occur in scattered areas of the west of AlUla in association with sandstone and granite areas.

GEOLOGY

Quartz sandstones predominantly derived from the Quweria Sandstone and Saq Sandstone.







SOILS

This alluvial soil is the result of the transport and deposition of sand particles, creating a lamellar structure. One of the characteristics of this soil is its high-water permeability.

VEGETATION

Open dwarf shrubland characteristically dominated by *Haloxylon salicornicum* with a herb layer (desert grassland) typically dominated by the grasses *Stipagrostis plumosa* and *Stipagrostis obtusa*. In areas, *Ephedra alata* and or *Retama raetam* become codominant with *Haloxylon salicornicum* often forming large nabkha.

In places, such as nabkha, where there is deeper sand, a desert herb community commonly with *Artemisia monosperma*, *Polycarpaea repens*, *Centropodia forskaolii*, and *Convolvulus cephalopodus* subsp. *bushiricus* develops becoming transitional with the deep sand dune community (3300).

FLORA

Characteristic flora

Perennials

- *Ephedra alata*
- *Haloxylon salicornicum*
- *Polycarpaea repens*
- *Retama raetam*
- *Stipagrostis ciliata*
- *Stipagrostis plumosa*


1


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Annuals

- *Anthemis deserti*
- *Arnebia hispidissima*
- *Asphodelus tenuifolius*
- *Ifloga spicata*
- *Medicago laciniata*
- *Monsonia nivea*
- *Neurada procumbens*
- *Plantago amplexicaulis*
- *Schismus barbatus*

High conservation value flora

- None

FAUNA

Characteristic fauna

- *Acanthodactylus schmidti* (Schmidt's fringe-fingered lizard)
- *Alaemon alaudipes* (Greater Hoopoe-lark)
- *Colotis danae* (Crimson tip)
- *Eremalauda eremodites* (Arabian Lark)
- *Felis lybica* (Afro-Asiatic wildcat)
- *Latrodectus revivensis* (Desert widow spider)
- *Ophiusa tirhaca*
- *Ptyodactylus ananjevae* (Ananjeva's fan-fingered gecko)
- *Sylvia borin* (Garden Warbler)

High conservation value fauna

- *Canis lupus* (Grey wolf)
- *Capra nubiana* (Nubian ibex)
- *Gazella arabica* (Arabian gazelle)
- *Gerbillus cheesmani* (Cheesman's gerbil)
- *Holocnemus pluchei* (Marbled daddy long-legs spider)

DEGRADATION

Overgrazing and off-road driving both have significant impacts.

RELATED HABITATS

- **3300** | SAND DUNES. Sandy plains grade naturally into sand dune systems where sand depth increases.
- **3200** | SAND SHEETS WITH EXPOSED BEDROCK. Found in a mosaic with this habitat in the northern AlUla.
- **5100** | SANDY WADIS. Sandy wadis often grade into sandy plains and may be difficult to distinguish on the ground in heavily degraded areas. Using satellite imagery can support interpretation.
- **4400** | GRAVEL PLAINS. In practice, the boundary between sandy and gravel plains is not always distinct, as many areas exhibit mixed substrates. Within this manual, plains are differentiated based in part on their geomorphological context: generally plains associated with sandstone landscapes are classified as Sandy plains (including sandy plains with some gravel), whereas plains associated with mountain systems of the Arabian Shield are classified as Gravel plains (4400).

1 *Capra nubiana* (Nubian ibex)
2 *Canis lupus* (Grey wolf)
3 *Gazella arabica* (Arabian gazelle)
4 *Sylvia borin* (Garden Warbler)
5 *Haloxylon salicornicum*





3200 | SAND SHEETS WITH EXPOSED BEDROCK

DESCRIPTION

Thin, discontinuous sandsheets overlie a lowrelief sandstone bedrock platform, with frequent areas of exposed rock.

GEOGRAPHIC AREA

Northeastern AlUla.

GEOLOGY

This can be observed in the Saq Sandstone. Due to the transgressive environment when the sediment was deposited, the softer river sediment erodes quicker, leaving the more compact sediments from the shallow seas exposed. Often iron beds, more resistant to erosion, and found in small higher relief exposures.

SOILS

This soil is characterised by a very shallow depth and a sandy texture, formed by the accumulation of mobile sand particles directly over the bedrock. It likely reflects limited weathering of the underlying parent material, combined with superimposed sand deposition. These soils are well-drained due to their coarse texture, facilitating excellent permeability and aeration. However, their nutrient retention capacity may be limited.

VEGETATION

Very sparse dwarf shrubland.

Characteristically dominated by *Rhanterium epapposum* with associated species such as *Fagonia glutinosa*, *Astragalus spinosus and Helianthemum lippii* with *Retama raetam* in sandy runnels. The density of this dwarf shrubland is variable but is generally very sparse due to overgrazing.

Local variation in the vegetation composition occurs depending on sand depth, bedrock topography, and proximity to other dune or rocky habitats, producing a mosaic of sandy patches, bare rock, and vegetated microsites.

FLORA

Characteristic flora

Perennials

- *Astragalus spinosus*
- *Ephedra alata*
- *Fagonia bruguieri*
- *Fagonia glutinosa*
- *Fagonia paulayana*
- *Gymnocarpos decander*
- *Haloxylon salicornicum*
- *Helianthemum lippii*
- *Kickxia aegyptiaca*
- *Launaea mucronata*
- *Plantago albicans*
- *Plantago amplexicaulis*
- *Retama raetam*
- *Rhanterium epapposum*
- *Stipagrostis ciliata*
- *Stipagrostis plumosa*
- *Stipellula capensis*
- *Zilla spinosa*


1


2


3


4

Annuals

- *Anisosciadium lanatum*
- *Anthemis* spp.
- *Crucianella membranacea*
- *Eremobium aegyptiacum*
- *Erodium laciniatum*
- *Koelpinia linearis*
- *Leysera leyseroides*
- *Medicago laciniata*
- *Picris* spp.
- *Plantago ciliata*
- *Schismus barbatus*

High conservation value flora

- *Thymbra nabateorum*

FAUNA

Characteristic fauna

- *Acanthodactylus schmidti* (Schmidt's fringe-fingered lizard)
- *Acanthodactylus tilburyi* (Tilbury's fringe-fingered lizard)
- *Alaemon alaudipes* (Greater Hoopoe-lark)
- *Anumeta spilota*
- *Buthacus yotvatensis* (Yotvata sand scorpion)
- *Cerastes gasperettii* (Gasperetti's viper)
- *Curruca nana* (Asian Desert Warbler)
- *Eliomys melanurus* (Black-tailed Garden dormouse)
- *Felis lybica* (Afro-Asiatic wildcat)
- *Latrodectus revivensis* (Desert widow spider)
- *Lepus capensis* (Cape hare)
- *Monticola solitarius* (Blue Rock-thrush)
- *Oenanthe oenanthe* (Northern Wheatear)
- *Orthonama obstipata*
- *Platyceps elegantissimus* (Elegant racer)
- *Psammophis schokari* (Schokari sand racer)
- *Pseudotrapelus sinaitus* (Sinai agama)
- *Ptyodactylus ananjevae* (Ananjeva's fan-fingered gecko)
- *Scincus conirostris* (Sandfish skink)
- *Spalerosophis diadema* (Diadem snake)
- *Steatoda cf. latifasciata* (False widow spider)
- *Stenodactylus doriae* (Dune sand gecko)
- *Uroctea cf. thaleri* (Bordered disc web spider)
- *Uromastyx aegyptia* (Egyptian mastigure)
- *Varanus griseus* (Desert monitor)

High conservation value fauna

- *Ammomanes cinctura* (Bar-tailed Lark)
- *Bubo ascalaphus* (Pharaoh Eagle-owl)
- *Canis lupus* (Grey wolf)
- *Capra nubiana* (Nubian ibex)
- *Circaetus gallicus* (Short-toed Snake-eagle)
- *Circus aeruginosus* (Western Marsh-harrier)
- *Falco concolor* (Sooty Falcon)
- *Pandesma robusta*
- *Psammomys obesus* (Fat sand rat)
- *Telescopus dhara* (Arabian cat snake)

DEGRADATION

This area is highly degraded with evidence of heavy grazing on shrubs.

RELATED HABITATS

3100 | SANDY PLAINS. Found in a mosaic with this habitat in northern AlUla.

1 *Curruca nana* (Asian Desert Warbler)
2 *Fagonia glutinosa*
3 *Kickxia aegyptiaca*
4 *Rhanterium epapposum*



3300 | SAND DUNES

DESCRIPTION

Mounds or ridge-like accumulations formed by aeolian deposition of loose sand. Often where sustained wind deposition has built up thick bodies of sand against rock outcrops or natural topographic barriers. For the purposes of this classification this habitat type also includes areas of deep sand.

GEOGRAPHIC AREA

Scattered across AlUla. Particularly in the sandstone areas of the east e.g. in the west of Sharaan National Park and South of Mughayra village and western borders of Wadi Nakhlah.

GEOLOGY

Quartz sandstones predominantly derived from the Quweria Sandstone and Saq Sandstone.

SOILS

Typical soil of dunes, formed and shaped by the wind, accumulating back to the wind and eroding in front of the wind. Fine particles are too light to settle and coarse elements too heavy to be carried by the wind. The soil structure is homogeneous, fragile, loose and permeable.






VEGETATION

Variable in density and composition ranging from unvegetated to open woodland depending on local factors including water availability, recent rainfall and dune stability.

Many dunes support only ephemeral annual vegetation following rainfall, with species such as *Anthemis desertii*, *Silene arabica*, *Monsonia nivea*, and *Neurada procumbens* appearing rapidly. Where dunes are more stable a characteristic open dwarf shrubland can develop including species such as *Centropodia forskaolii, Moltkiopsis ciliata* and *Convolvulus cephalopodus subsp. bushiricus.* In some areas, particularly on larger or more stable dune systems where there is deep ground water, *Haloxylon persicum* can form an open woodland.

FLORA

Characteristic flora

Perennials

- *Artemisia monosperma*
- *Calligonum comosum*
- *Centropodia forskaolii*
- *Convolvulus cephalopodus* subsp. *bushiricus*
- *Haloxylon persicum*
- *Haloxylon salicornicum*
- *Heliotropium digynum*
- *Moltkiopsis ciliata*
- *Polycarpaea repens*
- *Retama raetam*
- *Scrophularia hypericifolia*
- *Stipagrostis ciliata*
- *Stipagrostis drari*
- *Stipagrostis plumosa*









Annuals

- *Asphodelus tenuifolius*
- *Cakile arabica*
- *Crucianella membranacea*
- *Monsonia nivea*
- *Neurada procumbens*
- *Schismus barbatus*

High conservation value flora

Haloxylon persicum woodland is highlighted as a potential conservation priority vegetation type (Neale et al., 2023). *Haloxylon persicum* is an economically important rangeland plant throughout the sand deserts of KSA. It has heavily degraded across most of its range and almost certainly used to be much more widely distributed. It is a pivotal species for restoration of the sand dune habitats.

1 *Artemisia monosperma*
2 *Acanthodactylus schmidti*
(Schmidt's fringe-fingered lizard)
3 *Moltkiopsis ciliata*
4 *Convolvulus cephalopodus* subsp. *bushiricus*
5 *Haloxylon persicum*



5

FAUNA

Characteristic fauna

- *Acanthodactylus schmidti* (Schmidt's fringe-fingered lizard)
- *Acanthodactylus tilburyi* (Tilbury's fringe-fingered lizard)
- *Alaemon alaudipes* (Greater Hoopoe-lark)
- *Buthacus yotvatensis* (Yotvata sand scorpion)
- *Cerastes gasperettii* (Gasperetti's viper)
- *Cursorius cursor* (Cream-coloured Courser)
- *Eremalauda eremodites* (Arabian Lark)
- *Gerbillus dasyurus* (Wagner's gerbil)
- *Jaculus loftusi* (Arabian jerboa)
- *Stenodactylus doriae* (Dune sand gecko)
- *Uromastyx aegyptia* (Egyptian mastigure)

High conservation value fauna

- *Ammomanes cinctura* (Bar-tailed Lark)
- *Gerbillus cheesmani* (Cheesman's gerbil)
- *Pandesma robusta*

DEGRADATION

Off-road driving, overgrazing

RELATED HABITATS

- **3100** | SANDY PLAINS. Sand dunes grade naturally into sandy plains.
- **2100** | SANDSTONE OUTCROPS. Where sand blows up at the base of the buttes a mosaic of habitats can develop.



4000 | MOUNTAINS AND ASSOCIATED PLAINS

4100 | HIGH-ALTITUDE MOUNTAINS

4200 | MID-ALTITUDE MOUNTAINS

4300 | LOW-ALTITUDE MOUNTAINS

4400 | GRAVEL PLAINS

4000 | MOUNTAINS AND ASSOCIATED PLAINS

OUTLINE

The Mountains and associated plains comprise the Hijaz mountain systems of AlUla and their adjoining foothill and gravel plain environments. It spans a broad altitudinal gradient from rugged upland summits and steep slopes to lower foothills and depositional lowland plains.

The mountain landscapes are formed predominantly from Precambrian crystalline rocks of the Arabian Shield, creating rugged, dissected terrain with extensive areas of exposed bedrock and shallow soils. In contrast, the associated plains are composed of gravel and alluvial deposits derived from long-term erosion and downslope transport of mountain material.

Vegetation structure transitions from montane shrublands at high altitude to open Vachellia woodlands and perennial grasslands on foothills and plains.

High-altitude areas form a distinct ecological zone within AlUla, functioning as climatic and topographic refugia. These areas support a distinct flora and fauna with a higher proportion of range-restricted and conservation-significant species compared to the surrounding lower altitude areas. In addition to supporting a high proportion of range-restricted vascular plants and fauna, they also provide important refugial habitat for bryophytes and other cryptogams.

ASSOCIATED KSA NATIONAL ECOSYSTEM TYPES

- Hijaz Mountain Summits (1500–2500 m) habitat 4100
- Hijaz Hills and Mountains (300–1500 m) habitats 4200, 4300, and 4400

HABITATS

- **4100** | HIGH-ALTITUDE MOUNTAINS
- **4200** | MID-ALTITUDE MOUNTAINS
- **4300** | LOW-ALTITUDE MOUNTAINS
- **4400** | GRAVEL PLAINS



Figure 9 | Distribution of the habitat group Mountains and associated plains (4000) *in AlUla County.*







4100 | HIGH-ALTITUDE MOUNTAINS

DESCRIPTION

Mountainous uplands with summits, ridges and structural plateaus. Terrain ranges from gently sloping, to steep cliffs and convex summit areas. From around 1500m to the highest summit areas of Jabal AlWard (2096m) including associated runnels and gullies. Cooler and comparatively moister conditions support a distinct assemblage of plant and animal species, including endemic species and others of particular conservation significance.

High-altitude areas function as important refugia for cryptogams. Cooler temperatures, enhanced moisture availability and the presence of shaded cliffs, rock crevices and sheltered runnels support a distinctive bryophyte flora, including *Clevea spathysii, Molendoa handelii* and *Syntrichia rigescens* (Hugonnot et al., 2025b). These upland environments also provide favourable conditions for lichen communities, with Jabal AlWard identified as a particularly important area for future survey owing to its higher moisture availability and abundance of sheltered microhabitats (Marques et al., 2025).

GEOGRAPHIC AREA

Found on Jabal AlWard and in other small areas in the vicinity.

GEOLOGY

Precambrian igneous and metamorphic rocks.

SOILS

These shallow, gravelly soils of the high-altitude Hijaz are weakly developed under arid conditions, with profile evolution limited by physical weathering and aeolian deflation of fine particles. Their minimal horizon differentiation indicates an early stage of pedogenesis.

VEGETATION

Open shrubland characteristically dominated by *Retama raetam* and *Artemisia sieberi*. In some surveyed summit areas, the Saudi Arabian endemic *Euryops jaberiana* becomes codominant.

This is associated with a diverse mixed shrubland of dwarf shrubs such as *Ballota undulata*, *Teucrium polium*, *Astragalus spinosus*, *Ferula sinaica, Tanacetum sinaicum* and *Stachys aegyptiaca*. Trees such as *Pistacia khinjuk*, *Sageretia thea* and other species such as *Nepeta sheilae*, and *Umbilicus horizontalis* are found in more sheltered areas.


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FLORA

Characteristic flora

Perennials

- *Alcea striata*
- *Alkanna orientalis*
- *Anarrhinum orientale*
- *Artemisia sieberi*
- *Astragalus caprinus*
- *Astragalus spinosus*
- *Ballota undulata*
- *Bromus tectorum*
- *Centropodia forskaolii*
- *Colchicum ritchii*
- *Dianthus sinaicus*
- *Diplotaxis harra*
- *Echinops glaberrimus*
- *Erodium laciniatum* subsp. *pulverulentum*
- *Euryops jaberiana*
- *Farsetia aegyptia*
- *Ferula sinaica*
- *Filago griffithii*
- *Fumaria parviflora*
- *Galium sinaicum*
- *Globularia arabica*
- *Helianthemum lippii*
- *Hordeum murinum*
- *Morettia parviflora*
- *Nepeta sheilae*
- *Onopordum ambiguum*
- *Papaver glaucum*
- *Peganum harmala*
- *Phlomis brachyodon*
- *Pistacia khinjuk*
- *Retama raetam*
- *Sageretia thea*
- *Scandix stellata*
- *Searsia tripartita*
- *Stachys aegyptiaca*
- *Stipellula tigrensis*
- *Tanacetum sinaicum*
- *Teucrium polium*
- *Umbilicus horizontalis*

1 *Papaver glaucum* | **2** *Alcea striata*
3 *Aquila verreauxii* (Verreaux's Eagle)
4 *Searsia tripartita* | **5** *Teucrium polium*
6 *Psammophis schokari* (Schokari sand racer)

Annuals

- *Anchusa milleri*
- *Bromus danthoniae*
- *Bromus fasciculatus*
- *Isatis lusitanica*
- *Senecio glaucus*
- *Stipellula capensis*

High conservation value flora

- *Alcea striata*
- *Astragalus echinus*
- *Euryops jaberiana*
- *Ferula sinaica*
- *Nepeta sheilae*
- *Phlomis brachyodon*

FAUNA

Characteristic fauna

- *Gerbillus dasyurus* (Wagner's Gerbil)
- *Hecatera dysodea*
- *Lycosa piochardi* (Tarantula wolf spider)
- *Psammophis schokari* (Schokari sand racer)
- *Vulpes cana* (Blanford's Fox)

High conservation value fauna

- *Agrotis ipsilon*
- *Aquila chrysaetos* (Golden Eagle)
- *Aquila fasciata* (Bonelli's Eagle)
- *Aquila verreauxii* (Verreaux's Eagle)
- *Canis lupus* (Grey wolf)
- *Falco peregrinus (*Peregrine Falcon/ Barbary Falcon)
- *Helicoverpa armigera*
- *Heliothis nubigera*
- *Pandesma robusta*
- *Platyceps saharicus* (Saharan racer)

DEGRADATION

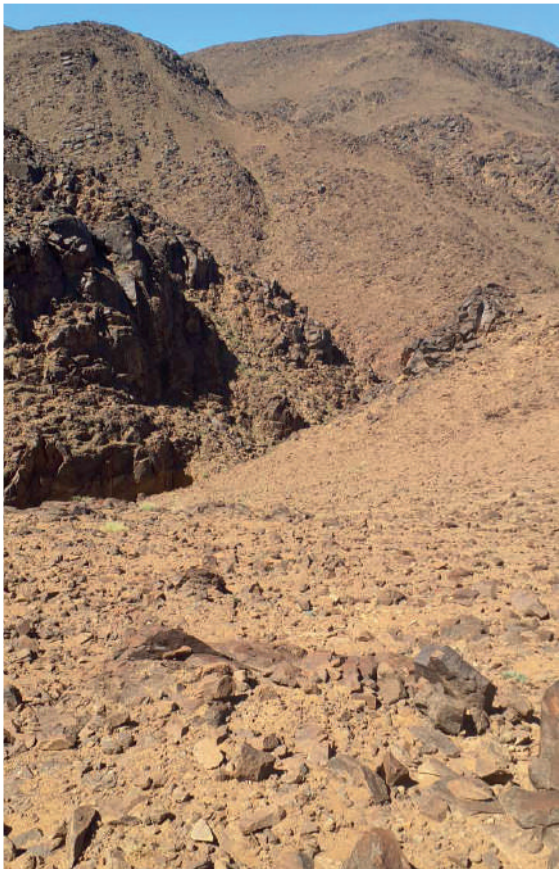
Inaccessible areas. Some grazing but it appears relatively limited in areas surveyed.

RELATED HABITATS

4200 | MID-ALTITUDE MOUNTAINS. These two habitats are delimited based on altitude.







4200 | MID-ALTITUDE MOUNTAINS

DESCRIPTION

Rocky mountain uplands of the Hijaz mountain area between about 1200 and 1500m with associated runnels and upper wadi systems. Mid-altitude mountains represent the transition between arid foothill systems and cooler high-altitude massifs.

GEOGRAPHIC AREA

Western and southern mountain areas.

GEOLOGY

Precambrian igneous and metamorphic rocks.

SOILS

These shallow, gravelly soils of the mid-altitude Hijaz have formed under arid conditions through the interplay of physical weathering and aeolian redistribution of fine particles.
Their profile expression remains weak, with limited horizon differentiation.

VEGETATION

Low montane shrubland.

Slopes are typically dominated by species such as *Helianthemum lippii* and *Gymnocarpos decander* with *Centaurea pseudosinaica* and *Fagonia mollis*. A characteristic *Retama raetam* and *Zilla spinosa* shrubland is found in areas of the west of AlUla with *Retama raetam* rare and concentrated in wadis and runnels at lower altitudes becoming more frequent at higher altitude.

In the runnels and wadis the vegetation becomes denser and is typically characterised by *Lycium shawii* and *Ephedra ciliata* shrubland with an associated mixed montane shrubs including *Blepharis ciliaris*, *Ochradenus baccatus*, *Gypsophila capillaris*, *Lavandula coronopifolia*, *Gymnocarpos decander*, *Helianthemum lippii*. Species such as *Teucrium polium* and *Otostegia fruticosa* found in wadis at higher altitudes and *Vachellia tortilis* subsp. *tortilis* woodland at lower altitudes.


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FLORA

Characteristic flora

Perennials

- *Blepharis ciliaris*
- *Ephedra ciliata*
- *Erodium hirtum*
- *Fagonia bruguieri*
- *Fagonia mollis*
- *Farsetia aegyptia*
- *Ferula ovina*
- *Forsskaolea tenacissima*
- *Gagea reticulata*
- *Gymnocarpos decander*
- *Gymnosporia senegalensis*
- *Helianthemum lippii*
- *Lavandula coronopifolia*
- *Lycium shawii*
- *Morettia parviflora*
- *Ochradenus baccatus*
- *Pistacia khinjuk*
- *Plantago ovata*
- *Ramaliella tortuosissima*
- *Retama raetam*
- *Sageretia thea*
- *Searsia tripartita*
- *Teucrium polium*
- *Verbascum shiqricum*
- *Zilla spinosa*

Annuals

- *Asphodelus tenuifolius*
- *Bromus tectorum subsp. tectorum*
- *Centaurea pseudosinaica*
- *Echium rauwolfii*
- *Matthiola longipetala*
- *Plantago afra*
- *Senecio flavus*
- *Stipellula capensis*
- *Trigonella stellata*

High conservation value flora

- *Aloe* cf. *porphyrostachys*
- *Daphne mucronata* subsp. *linearifolia*
- *Kickxia pseudoscoparia*

FAUNA

Characteristic fauna

- *Alectoris chukar* (Chukar)
- *Buteo buteo*
- *Lycosa piochardi* (Tarantula wolf spider)

High conservation value fauna

- *Agrotis ipsilon*
- *Aquila fasciata* (Bonelli's Eagle)
- *Aquila verreauxii* (Verreaux's Eagle)
- *Canis lupus* (Grey wolf)
- *Colotis chrysonome* (Golden arab)
- *Gnamptonyx innexa*
- *Holocnemus pluchei* (Marbled daddy long-legs spider)
- *Hyles livornica*
- *Oenanthe xanthoprymna* (Kurdish Wheatear)
- *Pandesma robusta*
- *Platyceps saharicus* (Saharan racer)

DEGRADATION

Overgrazing and woodcutting.

RELATED HABITATS

- **4100** | HIGH-ALTITUDE MOUNTAINS. These two habitats are delimited based on altitude.
- **4300** | LOW-ALTITUDE MOUNTAINS. These two habitats are delimited based on altitude.

1 *Gymnosporia senegalensis*
2 *Centaurea pseudosinaica*
3 *Lycium shawii*
4 *Oenanthe xanthoprymna* (Kurdish Wheatear)
5 *Zilla spinosa*









4300 | LOW-ALTITUDE MOUNTAINS

DESCRIPTION

Lower slopes and foothills of the Hijaz Mountains, extending from approximately 1200m down to surrounding plains and major wadi systems. The terrain is rugged and irregular, characterised by rocky slopes with associated runnels and gullies, screes and locally steep rock faces transitioning downslope into gentler terrain.

GEOGRAPHIC AREA

Widespread across the west and the south of AlUla.

GEOLOGY

Precambrian igneous and metamorphic rocks.

SOILS

The lower Hijaz foothills host shallow, gravelly soils weakly developed in arid conditions, where physical weathering prevails and wind erosion removes fine particles. Horizon differentiation remains minimal.


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VEGETATION

Very sparse montane herb vegetation with scattered shrubs and trees in drainage channels and wadis. Many slopes are largely unvegetated except for seasonal grass flushes dominated by Stipagrostis spp. Where vegetation is present, it is typically dominated by *Fagonia bruguieri*, *Forsskaolea tenacissima* and *Tetraena simplex*, with scattered *Lycium shawii* and shrubby *Vachellia* spp. In sheltered areas, remnants of a sparse drought-deciduous woodland persist, comprising species such as *Vachellia tortilis*, *Moringa peregrina*, *Senegalia hamulosa* and *Commiphora gileadensis*, with an understorey of *Lycium shawii*, *Lavandula coronopifolia*, *Ochradenus baccatus* and *Hibiscus micranthus*. Formerly more widespread, this woodland is now largely confined to sheltered wadis and rocky refugia following historical tree cutting.

FLORA

Characteristic flora

Perennials

- *Abutilon fruticosum*
- *Blepharis ciliaris*
- *Boerhavia sinuata*
- *Commiphora gileadensis*
- *Echinops glaberrimus*
- *Enneapogon persicus*
- *Ephedra ciliata*
- *Fagonia bruguieri*
- *Fagonia mollis*
- *Farsetia longisiliqua*
- *Forsskaolea tenacissima*
- *Gymnocarpos decander*
- *Gypsophila capillaris*
- *Heliotropium aegyptiacum*
- *Hibiscus micranthus*
- *Kohautia caespitosa*
- *Lavandula coronopifolia*
- *Lycium shawii*
- *Maerua crassifolia*
- *Morettia parviflora*
- *Moringa peregrina*
- *Ochradenus baccatus*
- *Otostegia fruticosa*
- *Panicum turgidum*
- *Senegalia hamulosa*
- *Stipagrostis hirtigluma*
- *Tephrosia purpurea* subsp. *apollinea*
- *Tetraena simplex*
- *Vachellia tortilis* subsp. *tortilis*
- *Vachellia tortilis* subsp. *raddiana*

Annuals

- *Asphodelus tenuifolius*
- *Centaurea pseudosinaica*
- *Rumex vesicarius*
- *Senecio flavus*

High conservation value flora

- *Kickxia pseudoscoparia*
- *Ramaliella intricata*
- *Trichodesma boissieri*

FAUNA

Characteristic fauna

- *Colotis danae* (Crimson tip)
- *Curruca leucomelaena* (Arabian Warbler)
- *Drasteria flexuosa*
- *Felis lybica* (Afro-Asiatic wildcat)
- *Freyeria trochilus* (Grass jewel)
- *Hypotacha ochribasalis*
- *Vulpes cana* (Blanford's fox)

High conservation value fauna

- *Canis lupus* (Grey wolf)
- *Capra nubiana* (Nubian ibex)
- *Colotis chrysonome* (Golden arab)
- *Heliothis nubigera*
- *Junonia hierta* (Yellow pansy)
- *Otus brucei* (Pallid Scops-owl)
- *Pandesma robusta*

RELATED HABITATS

4200 | MID-ALTITUDE MOUNTAIN. These two habitats are delimited based on altitude.

DEGRADATION

Principal drivers of degradation include overgrazing and woodcutting.

1 *Tricodesma boisseri* | **2** *Vachellia tortilis* subsp. *tortilis* | **3** *Moringa peregrina* | **4** Otus brucei (Pallid Scops-owl)









4400 | GRAVEL PLAINS

DESCRIPTION

Plains and low slopes of the Hijaz mountains area covered in loose gravel and rocks.

Gravel plains comprise gently undulating to locally sloping surfaces characterised by a covering of loose gravel, stones, and coarse clasts. These plains occur at the base of mountain systems and across intermontane areas and intermediate between rocky mountain slopes and sandy plains.

GEOGRAPHIC AREA

In the south and west of AlUla, the Hijaz area.

GEOLOGY

Precambrian igneous and metamorphic rocks. In some areas broken pieces of sub-rounded igneous rocks. In areas with metamorphic rock, angular fragments are common. Often the gravel plains will contain high concentrations of calcite or quartz minerals on the surface, of varying sizes.

SOILS

These soils, derived from moderate alluvial deposits, are composed of loamy-sand to gravel particles, differential erosion leaves heavier particles like gravels on the surface, inducing slight soil compaction between deposit layers.





3

VEGETATION

Vegetation is variable depending on factors such as degradation.

It ranges from very open *Vachellia tortilis* subsp. *raddiana* and *Vachellia tortilis* subsp. *tortilis* woodland with an understory of *Haloxylon salicornicum, Ochradenus baccatus, Panicum turgidum* and *Lycium shawii* through to a sparse shrubland of *Vachellia* spp. with very occasional *Haloxylon salicornicum* eventually becoming denuded plains.

FLORA

Characteristic flora

Perennials

- *Fagonia bruguieri*
- *Fagonia paulayana*
- *Haloxylon salicornicum*
- *Lycium shawii*
- *Morettia parviflora*
- *Senna italica*
- *Vachellia tortilis* subsp. *raddiana*
- *Vachellia tortilis* subsp. *tortilis*

Annuals

- *Aizoon canariense*
- *Aristida adscensionis*
- *Asphodelus tenuifolius*
- *Schismus barbatus*

High conservation value flora

- None

FAUNA

Characteristic fauna

- *Alaemon alaudipes* (Greater Hoopoe-lark)
- *Buthacus yotvatensis* (Yotvata sand scorpion)
- *Curruca nana* (Asian Desert Warbler)
- *Cursorius cursor* (Cream-coloured Courser)
- *Eremalauda eremodites* (Arabian Lark)
- *Eremophila bilopha*
- *Gerbillus dasyurus* (Wagner's gerbil)
- *Jaculus loftusi* (Arabian jerboa)
- *Psammophis schokari* (Schokari sand racer)
- *Pseudotrapelus sinaitus* (Sinai agama)
- *Sympetrum fonscolombii* (Red-veined darter)
- *Uromastyx aegyptia* (Egyptian mastigure)

High conservation value fauna

- *Agrotis ipsilon*
- *Ammomanes cinctura* (Bar-tailed Lark)
- *Bubo ascalaphus* (Pharaoh Eagle-owl)
- *Capra nubiana* (Nubian ibex)
- *Heliothis nubigera*
- *Hyles livornica*

DEGRADATION

Impacted by overgrazing and woodcutting. However, impact is very variable, some areas are extremely degraded with no or very limited vegetation, other areas retain an open woodland.

RELATED HABITATS

- **5200** | GRAVEL WADIS. It can at times be extremely difficult to distinguish between gravel plains and wadis on the ground. Satellite imagery can support this distinction.
- **3100** | SANDY PLAINS. The boundary between sandy and gravel plains is not always distinct, as many areas exhibit mixed substrates. Within this manual, plains are differentiated based partly on their geomorphological context: generally plains associated with sandstone are classified as Sandy plains (3100) including sandy plains with some gravel, whereas plains associated with mountain systems of the Arabian Shield are classified as Gravel plains (4400).

1 *Vachellia tortilis* subsp. *raddiana*
2 *Vachellia tortilis* subsp. *tortilis*
3 *Ammomanes cinctura* (Bar-tailed Lark)



5000 | WADIS AND EPHEMERAL FLOODED DEPRESSIONS

5100 | SANDY WADIS

5200 | GRAVEL WADIS

5300 | EPHEMERAL FLOODED DEPRESSIONS

5000 | WADIS AND EPHEMERAL FLOODED DEPRESSIONS

OUTLINE

Wadis comprise the network of ephemeral drainage systems across AlUla, ranging from small incised channels and tributaries to broad valley floors. They are shaped by episodic surface water flow following rainfall and act as major conduits for sediment, water, nutrients, and biological connectivity across the landscape.

ASSOCIATED KSA NATIONAL ECOSYSTEM TYPES

Mixed

LIST OF HABITATS

- **5100** | SANDY WADIS
- **5200** | GRAVEL WADIS
- **5300** | EPHEMERAL FLOODED DEPRESSIONS

RELATED HABITATS

1300 Harrat drainage lines and wadis while functionally similar are treated under the Volcanics habitat.

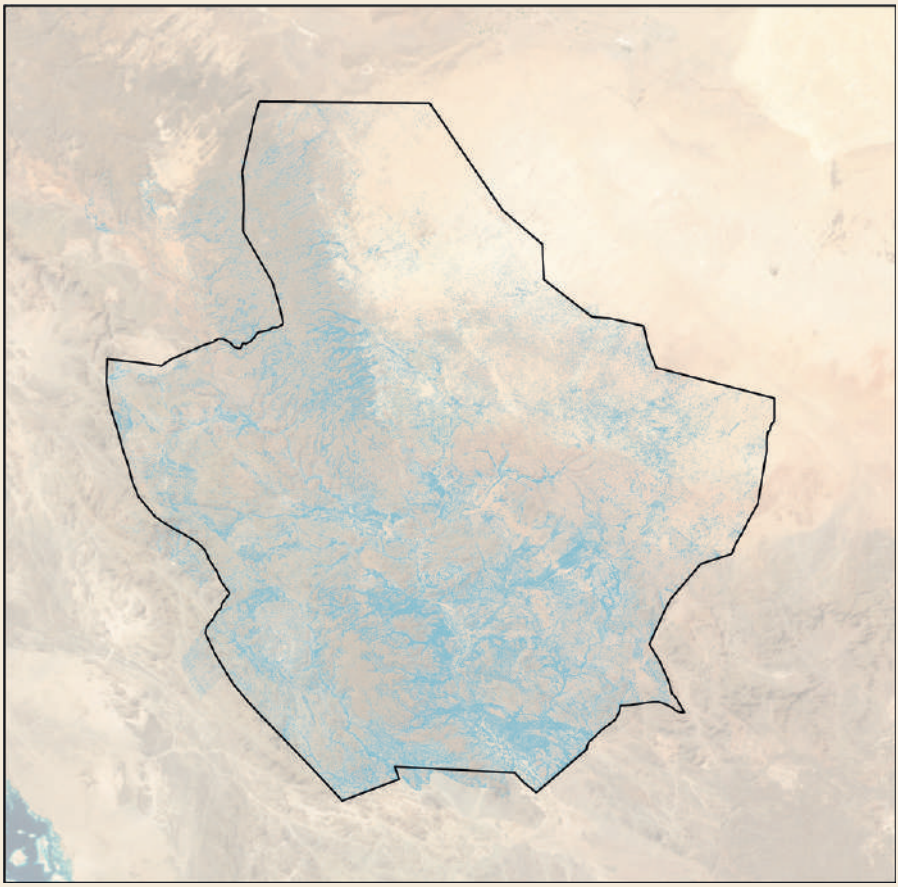


Figure 10 | Distribution of habitat group Wadis and ephemeral flooded depressions (5000) in AlUla County.







5100 | SANDY WADIS

DESCRIPTION

Dry ephemeral riverbed characterised by aeolian and alluvial sand deposits, supporting a woody vegetation denser than that of the surrounding sandy plains.

GEOGRAPHIC AREA

Primarily found in the east of AlUla associated with areas of sandstone.

GEOLOGY

Predominantly Siq and Quweria sandstones, but in areas close to the harrats, basalt boulders can be found mixed with the sandstone.

SOIL

These SOILS are dominated by sand and formed from sediments deposited during episodic fluvial flows. Their sandy texture reflects low-energy water transport, allowing fine particles to settle while coarser debris is washed away, and their formation is strongly influenced by the frequency and intensity of seasonal floods.

VEGETATION

Open Vachellia woodland.

Typically dominated by *Vachellia tortilis* subsp. *raddiana* at lower altitudes and *Vachellia gerrardi* var. *najdensis* at over 1000m. With a shrubland dominated by *Retama raetam* and *Haloxylon salicornicum.*





FLORA

Characteristic flora

Perennials

- *Astragalus spinosus*
- *Citrullus colocynthis*
- *Gymnocarpos decander*
- *Haloxylon salicornicum*
- *Lycium shawii*
- *Ochradenus baccatus*
- *Panicum turgidum*
- *Retama raetam*
- *Stipagrostis plumosa*
- *Vachellia gerrardi* var. *najdensis*
- *Vachellia tortilis* subsp. *raddiana*

Annuals

- *Aizoon canariense*
- *Asphodelus tenuifolius*
- *Cakile arabica*
- *Crucianella membranacea*
- *Ifloga spicata*
- *Medicago laciniata*
- *Plantago amplexicaulis*
- *Rumex vesicarius*
- *Schismus barbatus*
- *Stipellula capensis*

High conservation value flora

- None

FAUNA

Characteristic fauna

- *Acanthodactylus schmidti* (Schmidt's fringe-fingered lizard)
- *Artema nephilit* (Giant daddy-long-leg spider)
- *Buthacus yotvatensis* (Yotvata sand scorpion)
- *Casama innotata*
- *Cerastes gasperettii* (Gasperetti's viper)
- *Curruca nana* (Asian Desert Warbler)
- *Felis lybica* (Afro-Asiatic wildcat)
- *Hypotacha ochribasalis*
- *Hypsugo ariel* (Fairy Pipistrelle)
- *Jaculus loftusi* (Arabian jerboa)
- *Lytorhynchus diadema* (Crowned leafnose snake)
- *Palpimanus gibbulus*
- *Phoenicurus ochruros*
- *Plecotus christii* (Christie's big-eared bat)
- *Psammophis schokari* (Schokari sand racer)
- *Pseudotrapelus sinaitus* (Sinai agama)





- *Ptyodactylus ananjevae* (Ananjeva's fan-fingered gecko)
- *Steatoda cf. paykulliana*
- *Stenodactylus doriae* (Dune sand gecko)
- *Streblote acaciae*
- *Tathorhynchus exsiccata*
- *Uromastyx aegyptia* (Egyptian mastigure)
- *Uromastyx ornata* (Ornate mastigure)
- *Varanus griseus* (Desert monitor)

High conservation value fauna

- *Barbastella leucomelas* (Eastern Barbastelle)
- *Bubo ascalaphus* (Pharaoh Eagle-owl)
- *Capra nubiana* (Nubian ibex)
- *Falco concolor* (Sooty Falcon)
- *Gazella arabica* (Arabian gazelle)
- *Gerbillus cheesmani* (Cheesman's Gerbil)
- *Gnamptonyx innexa*
- *Heliothis nubigera*
- *Oryx leucoryx* (Arabian Oryx)
- *Pandesma robusta*
- *Platyceps saharicus* (Saharan racer)
- *Psammomys obesus* (Fat Sand Rat)

DEGRADATION

Grazing, woodcutting, off-road driving.

RELATED HABITATS

- **3100** | SANDY PLAINS. Typically differentiated by the contracted vegetation of the wadi bed but this can be difficult in very degraded areas.
- **2300** | SANDSTONE CANYONS. Many sandy wadis originate within or pass through canyon systems.

1 *Vachellia gerrardi* var. *najdensis*
2 *Medicago laciniata*
3 *Uromastyx ornata* (Ornate mastigure)
4 *Oryx leucoryx* (Arabian Oryx)









5200 | GRAVEL WADIS

DESCRIPTION

Dry, ephemeral riverbeds characterised by coarse alluvial substrates, including boulders, cobbles, pebbles, and gravel. This habitat also includes alluvial fans.

GEOGRAPHIC AREA

Associated with the mountain, foothills and plains of the Hijaz mountain areas.

GEOLOGY

Mostly a mixture of igneous and metamorphic rocks.

SOIL

These SOILS, shaped by fluvial deposits and erosion processes, are downstream of stony and unstable reliefs. The stony composition of these soils testifies to the strength and turbulence of the floods. The stratification of the soil testifies to variations in the speed of the water current.



VEGETATION

Vegetation is variable depending on factors such as degradation.

It ranges from very open *Vachellia tortilis* subsp. *raddiana* and *Vachellia tortilis* subsp. *tortilis* woodland with an understory of *Haloxylon salicornicum, Ochradenus baccatus, Lycium shawii, Panicum turgidum,* through to a sparse shrubland of *Vachellia* spp. with very occasional *Haloxylon salicornicum,* through to wadis which are completely denuded.

FLORA

Characteristic flora

Perennials

- *Aristida adscensionis*
- *Citrullus colocynthis*
- *Fagonia bruguieri*
- *Forsskaolea tenacissima*
- *Haloxylon salicornicum*
- *Lycium shawii*
- *Morettia parviflora*
- *Ochradenus baccatus*
- *Rhazya stricta*
- *Tetraena simplex*
- *Vachellia tortilis* subsp. *tortilis*
- *Vachellia tortilis* subsp. *raddiana*

Annuals

- *Aizoon canariense*
- *Asphodelus tenuifolius*
- *Tribulus terrestris*

1 *Tetraena simplex*
2 *Tribulus terrestris*
3 *Vachellia tortilis* subsp. *raddiana*



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FAUNA

Characteristic fauna

- *Colotis halimede* (Yellow patch white)
- *Colotis liagore* (Desert orange tip)
- *Curruca leucomelaena* (Arabian Warbler)
- *Daphnis nerii*
- *Freyeria trochilus* (Grass jewel)
- *Hypotacha ochribasalis*
- *Streblote acacia*

High conservation value fauna

- *Canis lupus* (Grey wolf)
- *Capra nubiana* (Nubian ibex)
- *Gnamptonyx innexa*
- *Heliothis nubigera*

DEGRADATION

Overgrazing and woodcutting.

RELATED HABITATS

- **5100** | SANDY WADIS. Transitional zones between gravel and sandy wadis are common and should be classified based on dominant substrate and channel form.
- **4400** | GRAVEL PLAINS. In some areas, particularly where drainage channels are broad or poorly defined, gravel wadis can be difficult to distinguish from adjacent gravel plains. Wadis are typically associated with active drainage features and evidence of periodic flooding, whereas gravel plains occur outside the main fluvial system.
- **5300** | EPHEMERAL FLOODED DEPRESSIONS. Ephemeral flooded depressions may occur within or adjacent to gravel wadi systems where water accumulates in localised low-lying areas. These depressions are characterised by prolonged water retention and distinct soil and vegetation conditions compared with the surrounding wadi habitat.















5300 | EPHEMERAL FLOODED DEPRESSIONS

DESCRIPTION

Ephemeral flooded depressions are shallow basins that temporarily hold water following rainfall. As the water recedes, these microsites support short-lived but diverse annual growth, often including halophytic species adapted to saline, fine textured soils. During the driest months, vegetation cover is minimal and the exposed silty-clay surfaces are highly vulnerable to wind erosion. Despite their limited extent and brief hydroperiod, larger depressions function as important ecological hotspots, providing seasonal foraging habitat for a range of bird species that utilise the vegetation flush and temporary moisture.

GEOGRAPHIC AREA

Widespread across AlUla.

GEOLOGY

Variable, dependant on the location of depression.

SOILS

Ephemeral flooded microsites are flat depression basins. Soils are highly compacted with a high silt and clay, making them low permeable. Some areas also present some salt crust. The area experiences temporary flooding after heavy rainfall events.

VEGETATION

Variable depending on the location of the depressions, seasonality and levels of degradation. Frequently dominated by halophytic species.



1



2



3



4





FLORA

Characteristic flora

Perennials

- *Anabasis setifera*
- *Andrachne telephioides*
- *Asteriscus graveolens*
- *Atriplex turcomania*
- *Caroxylon imbricatum*
- *Farsetia aegyptia*
- *Seidlitzia rosmarinus*
- *Suaeda spp.*
- *Traganum nudatum*

Annuals

- *Aizoon canariense*
- *Lepidium aucheri*
- *Malva parviflora*
- *Polycarpaea robbairea*

High conservation value flora

None

FAUNA

Characteristic fauna

- *Uromastyx aegyptia* (Egyptian mastigure)
- *Varanus griseus* (Desert monitor)
- *Platyceps saharicus* (Saharan racer)

High conservation value fauna

- *Barbastella leucomelas* (Eastern Barbastelle)
- *Bubo ascalaphus* (Pharaoh Eagle-owl)
- *Gazella arabica* (Arabian gazelle)
- *Platyceps saharicus* (Saharan racer)

DEGRADATION

Overgrazing, off-road driving.

RELATED HABITATS

1500 | EPHEMERAL FLOODED DEPRESSIONS IN VOLCANIC CRATERS – can be distinguished by location.

1 *Platyceps saharicus* (Saharan racer) | **2** *Polycarpaea robbairea* | **3** *Anabasis setifera* | **4** *Suaeda vermiculata*



6000 | AGRICULTURAL LANDS

6100 AGRICULTURAL LANDS

6000 | AGRICULTURAL LANDS

DESCRIPTION

Agricultural lands comprise areas that are actively or recently managed for crop production, oases, or irrigated cultivation. These landscapes are strongly shaped by longterm human management, water abstraction, and soil modification, and form an important component of the cultural landscape of AlUla.

Agricultural lands occur primarily within valley floors, oases, and lowlying plains where access to groundwater, springs, or surface water has enabled sustained cultivation.

ASSOCIATED KSA NATIONAL ECOSYSTEM TYPES

Not applicable

HABITATS

6100 | AGRICULTURAL LANDS

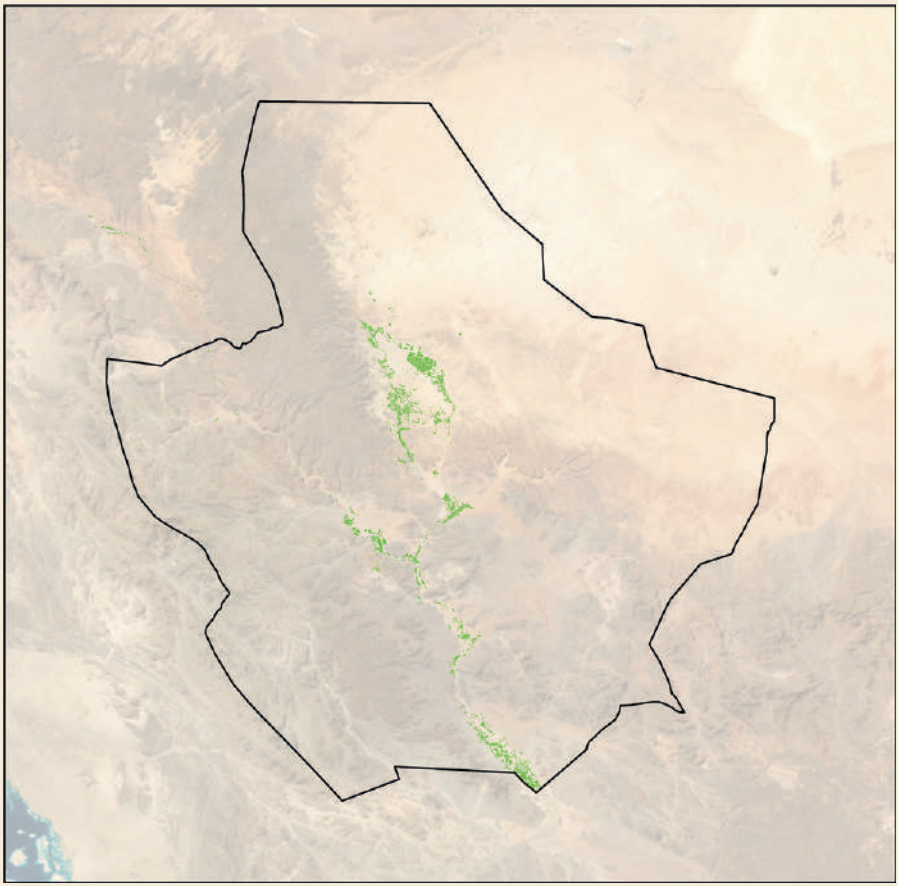
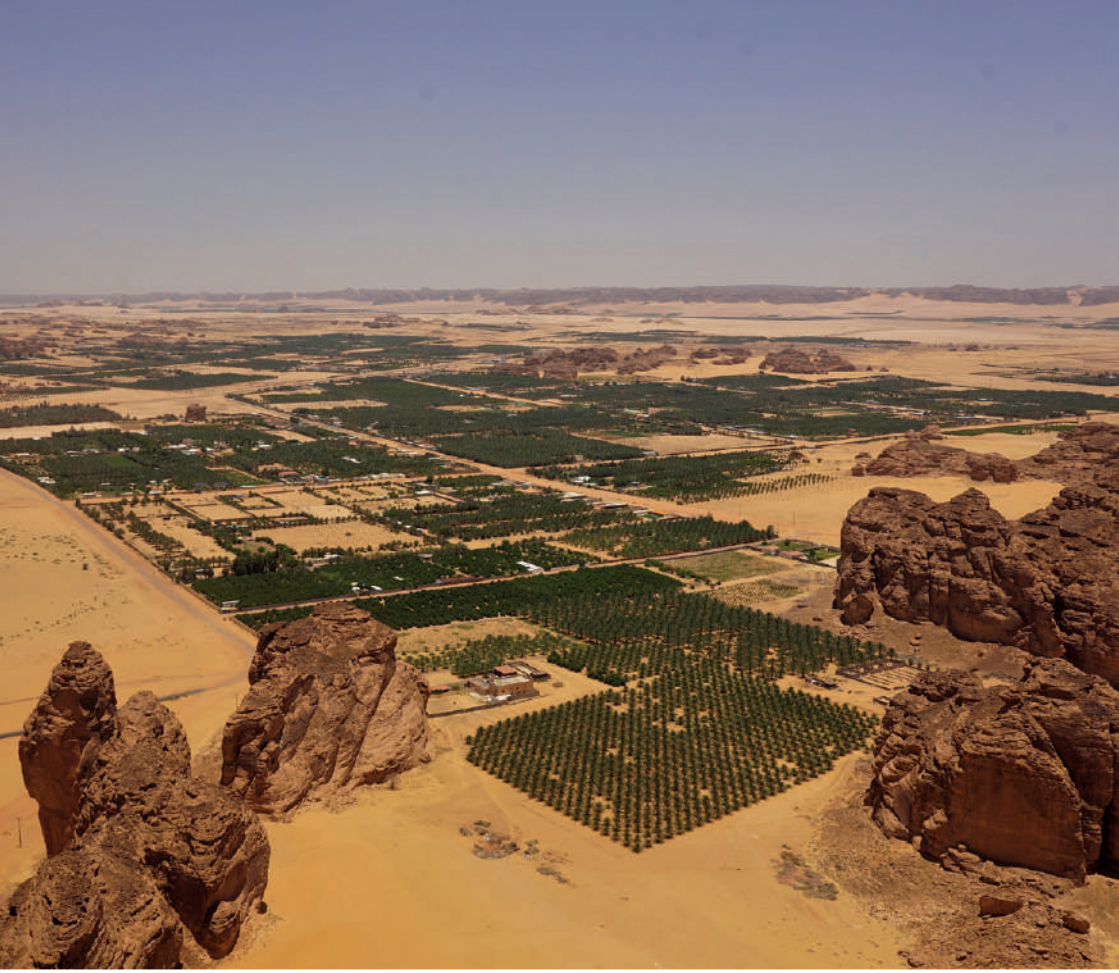


Figure 11 | Distribution of habitat group Agricultural lands (6000) in AlUla County.







6100 | AGRICULTURAL LANDS

OUTLINE

This includes all agricultural land in AlUla, including the oasis areas, fields and pivot agriculture, both in areas where agriculture is active and in recently abandoned areas.

GEOGRAPHIC AREA

Found across AlUla with the largest concentration around the AlUla valley.

GEOLOGY

Typically underlain by Quaternary fluvial deposits associated with wadis and valley floors, with bedrock geology varying depending on location (sandstone, volcanic, or crystalline basement).

SOILS

Agricultural soils show strong variability depending on local topography and hydrological conditions. Agricultural activities are mainly concentrated in plain areas, where soils range from sandy loam to more clay-rich textures. These soils are often compacted and may exhibit chemical imbalances, as well as localised salt accumulation.

VEGETATION

Vegetation is dominated by cultivated (particularly date palm *Phoenix dactylifera*), non-native fruit trees, and seasonal crops. Some agricultural areas can support a relatively high diversity of weedy and ruderal plant species, reflecting frequent disturbance, irrigation, nutrient enrichment, and the mixing of native, naturalised, and introduced taxa.

FLORA

Characteristic flora

- *Alhagi maurorum*
- *Celosia trigyna*
- *Cenchrus echinatus* (non-native)
- *Euploca ovalifolia*
- *Momordica balsamina*
- *Setaria viridis*

FAUNA

Characteristic fauna

- *Brephidium exilis* (Western pygmy blue)
- *Chalcides ocellatus* (Ocellated bronze skink)
- *Euodice cantans*
- *Gegenes nostrodamus* (Mediterranean skipper)
- *Hemidactylus granosus* (Grainy house gecko)
- *Hogna sp.*
- *Larinia chloris*
- *Leptotes pirithous* (Lang's short-tailed blue)
- *Oecobius sp.*
- *Pelopidas mathias* (Black-branded swift)
- *Ploceus galbula*
- *Pycnonotus leucotis*
- *Spalerosophis diadema* (Diadem snake)
- *Thyene imperialis*
- *Zizeeria karsandra* (Dark grass blue)

High conservation value fauna

- *Junonia hierta* (Yellow pansy)
- *Junonia orithya* (Blue pansy)
- *Pipistrellus kuhlii* (Kuhl's Pipistrelle)
- *Rousettus aegyptiacus* (Egyptian Rousette)
- *Streptopelia turtur* (European Turtle-dove)



MICRO HABITATS







MICRO HABITATS

OUTLINE

These are highly localised habitat types that have not been mapped. Although requiring further characterisation, they represent important features of ecological significance in AIUla and are therefore included here in brief. These microhabitats are also of particular importance for bryophytes, which are largely restricted to sites with locally enhanced moisture availability. Notable species include the aquatic liverwort *Riella affinis*, known from only two ponds in Sharaan, together with the wetland and seepage specialists *Ptychostomum cellulare*, *Ptychostomum pseudotriquetrum, Gymnostomiella vernicosa.* and *Eucladium verticillatum* (Hugonnot et al., 2025b). These habitats act as important moisture refugia within an otherwise hyper-arid landscape and support several species considered to be of high conservation importance in AlUla. The occurrence of these species highlights the ecological value of small-scale refugia and moisture-dependent habitats within AlUla's predominantly arid landscape, reinforcing the importance of protecting seepages, canyon systems and montane habitats that support disproportionately high biodiversity. Similar moisture-buffered microhabitats are also recognised as key centres of lichen diversity, particularly where seepages, rock crevices and stable substrates provide protection from desiccation stress (Marques et al., 2025).



SEEPAGE

Sandstone seepages are highly localised microhabitats formed where groundwater emerges slowly along sandstone fractures, bedding planes, or rock faces. They occur mainly in shaded cliffs, ledges, boulder slopes, and canyon walls, creating persistent moist microsites within otherwise arid areas. Although limited in extent, seepages support distinctive moisture-dependent vegetation and act as important ecological refugia.

VEGETATION

Vegetation is typically small scale and highly localised but structurally distinct from surrounding habitats. Plant cover may include ferns, sedges, and moisture-dependent herbs, often accompanied by shrubs or trees rooted nearby that benefit from enhanced water availability.

1 *Periploca aphylla*
2 *Ficus palmata* subsp. virgata
3 *Adiantum capillus-veneris*



1



2



MOUNTAIN SPRINGS AND POOLS

Where groundwater emerges naturally at the surface producing visible flowing water, persistent wet ground, or localised pooling. Springs support distinctive vegetation that differs markedly from surrounding dry habitats. This may include dense shrub or tree growth, hygrophilous herbs, reeds, or ferns, reflecting consistently elevated moisture availability. As a result, springs function as important ecological focal points, providing water, shade, and foraging resources for a wide range of fauna and acting as long-term refugia within otherwise arid environments.

FLORA

Characteristic flora

Perennials

- *Adiantum capillus-veneris*
- *Cynodon dactylon*
- *Ephedra ciliata*
- *Ficus palmata* subsp. *virgata*
- *Haloxylon salicornicum*
- *Juncus rigidus*
- *Launaea spinosa*
- *Lavandula pubescens*
- *Periploca aphylla*
- *Phoenix dactylifera*
- *Pistacia khinjuk*
- *Retama raetam*
- *Vachellia gerrardi* var. *najdensis*

Annuals

- *Schismus barbatus*
- *Senecio flavus*

FAUNA

Characteristic fauna

- Not yet determined

1 *Juncus rigidus*
2 *Mentha longifolia*

FLORA

- *Andrachne aspera* var. *glandulosa*
- *Chrozophora oblongifolia*
- *Farsetia aegyptia*
- *Forsskaolea tenacissima*
- *Juncus rigidus*
- *Mentha longifolia*
- *Phragmites australis*
- *Pulicaria arabica*
- *Pulicaria undulata* subsp. *undulata*
- *Typha domingensis*
- *Verbascum sinaiticum*
- *Zilla spinosa*

FAUNA

- *Bufotes sitibundus* (Variable green toad)
- *Duttaphrynus dhufarensis* (Oman toad)
- *Sclerophrys arabica* (Arabian toad)



GLOSSARY

BIBLIOGRAPHY

APPENDIX 1
FLORA NAMES

APPENDIX 2
FAUNA NAMES

GLOSSARY

TERM | DEFINITION

Aeolian | Wind-driven. Used to describe landforms, sediments, and geological processes shaped by the action of wind.

Alluvial fan | Alluvial fan deposits are low, outspread, relatively flat to gently sloping masses of loose rock material, shaped like a fan or segment of a cone. They are deposited by streams at the mouths of tributary valleys onto a plain or broad valley.

Butte | An isolated hill with steep sides and a flat, slightly rounded top.

Canyon | Large chasms between cliffs.

Clasts | Fragments or grains of pre-existing rocks and minerals.

Crater | The top of a volcano, which is lower than the surrounding rim.

Decreaser species | Species that are present in an area with low to no degradation, with balanced ecosystem dynamics and controlled grazing conditions. These species are often palatable and are hence coined “decreasers” given their tendency to decrease as environmental degradation heightens in intensity.

Degradation | The process by which the quality of a natural habitat is reduced, making it less able to support wildlife. This can be caused by human or natural causes. In this context we refer to human causes.

Ecosystem type | Complex of organisms and their associated physical environment that are united by similar ecological processes and that exhibit substantial differences in biotic structure and composition to that of other ecosystem types.

Endemic species | Plants or animals existing naturally in a specific geographic region. For example, national endemics which are found only in Saudi Arabia or Arabian endemics which are found only in the countries of the Arabian Peninsula.

Geographically restricted | Fauna species with a limited distribution, defined as having an Area of Occupancy (AOO) of <10 km² and/or an Extent of Occurrence (EOO) of <100 km², following the IUCN methodology for estimating species range size.

Geomorphology | Branch of geology that is concerned with the structure, origin, and development of the topographical features of the earth’s surface.

Habitat | Plant and animal communities as the characterising elements of the biotic environment, together with abiotic factors (soil, climate, water availability and quality, and others), operating together at a particular scale, following the EUNIS definition (European Environment Agency, 2023).

Harmonised | The process of aligning and integrating data from different sources, methodologies, or classification systems to create a consistent and comparable dataset.

Harrats | Lava flows giving rise to high plateau. Harraat surfaces clearly reflect their age. Older harraat are severely weathered and eroded. Younger harraat have little weathering or erosion and can appear as an impassable and chaotic jumble of angular blocks.

Increaser species | Species that might be native to KSA (therefore aren't alien invasives) but are quick-spreading species related to environmental degradation or overgrazing. Some may be unpalatable to grazers. Some may compete with established plant species/communities in the given area when environmental degradation commences or intensifies.

Inselberg | Isolated rock hill, ridge, or small mountain, that rises abruptly from a virtually level surrounding plain.

IUCN Red List | A globally recognised system for assessing the extinction risk of species using standard conservation status categories, including Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD) and Not Evaluated (NE).

Lamellar | Rocks, minerals, or soils composed of fine, alternating, parallel layers or flat plates.

Lava flow | A stream or sheet of molten or solidified lava which has erupted from a volcano onto the Earth's surface. Lava flows in a solidified context can be described as fresh or eroded.

Mesa | A flat-topped hill with steep sides. They are smaller than a plateau and the sides are much steeper. Mesa can be separated from a plateau in AlUla as they are typically in the sedimentary rocks. The plateau is seen as the harrats.

Mountain | A naturally raised landform, with steep, sharp edges and a peak.

Nabkha | Accumulation of wind-blown sediment around plants forming a raised fertile mound.

Outcrop | An area of exposed rock sticking out from the surrounding ground.

Overgrazing | Intensive grazing by animals on an area of land, particularly rangelands and grasslands, such that vegetation is damaged and the soil becomes liable to erosion by wind and rain, sometimes resulting in desertification.

Pediment | A gently sloping bedrock surface that forms at the base of a mountain or hill. Often covered by a thin layer of gravel or alluvium.

Pediplain | Extensive gently sloping plain formed by the joining of multiple pediments at the base of a mountain range.

Pedogenesis | The process of soil formation.

Plateau | A large flat expanse that rises above the surrounding landscape, they often rise steeply above.

Pyroducts | A natural tube formed through the flow of lava. When emptied of lava it can resemble a tube or elongated cave. Also called a lava tube.

Quweria Sandstone | A sandstone formation in AlUla. Defined by its honey-coloured, fairly massive layers, dominated by fluvial deposits and quartz sediment. The cement is relatively weakened through hydrolysis and chemical weathering.

Range restricted | Refers to species that are known to occur in Saudi Arabia and neighbouring countries. They are not considered regional endemics but have a restricted range.

Refugia | Areas that components of biodiversity retreat to, persist in, and can potentially expand from under changing environmental conditions.

Runnel | A small stream or channel.

Sand sheet | Low-relief sand surfaces largely devoid of dunes although they may exhibit low-relief aeolian features.

Saq Sandstone | The youngest sandstone formation in AlUla. It is a medium-grained, well-rounded sands, with graded bedding, interlaid with shallow marine deposits, demonstrating a transgressive environment. The cement is relatively weakened through hydrolysis and chemical weathering, whereas the marine deposits demonstrate hard iron beds.

Shear zone | Result of faulting from tectonic movements of the opening of the Red Sea, where strain in the rock forces opposing sides to slide past each other. At the fault, the rock is broken and more brittle than the surrounding rock, and these act as weak spots where erosion works faster.

Siq Sandstone | Oldest sandstone formation in AlUla. The formation is composed of several thick beds of medium to coarse-grained beds, with large cross-bedding throughout, indicating high-energy fluvial channels.

Substrate | In ecological terms this is the substance, surface, or base upon which biological processes occur or an organism lives.

Tafoni features | Rounded smooth cavities or hollows in rock. Often grouped and described as honeycomb weathering.

Un-weathered lava flow | As fresh lava flow. Where the basalt lava has not been significantly eroded.

Vegetation type | Dominant plant species and their structural characteristics in an area.

Volcanic cone | A hill-shaped landform that forms around a volcano.

Wadi | The river channel but can also include the floodplain and associated valley of a stream that is usually dry except during the rainy seasons.

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APPENDIX 1

FLORA NAMES

A list of all the plant names used in the manual with their family, authorities and commonly found synonyms. Complete synonymy is available in Stott et al. 2026. Nomenclature and taxonomic status follow World Flora Online unless otherwise stated in Stott et al. 2026. Taxa highlighted have been identified as of high conservation significance, based on national endemism, restricted range and rarity or their threatened status on the IUCN Red List. Conservation status categories abbreviations:

- **CR** – Critically Endangered
- **EN** – Endangered
- **VU** – Vulnerable
- **NT** – Near Threatened
- **LC** – Least Concern
- **DD** – Data Deficient
- **NE** – Not Evaluated
- **IUCN Red List** status is global unless indicated as a regional assessment for the Arabian Peninsula

SPECIES	FAMILY	SYNONYMS	IUCN STATUS	DISTRIBUTION	CONSERVATION PRIORITY
Abutilon bidentatum (Hochst.) A.Rich.	Malvaceae		NE	Widespread	
Achillea fragrantissima Sch. Bip.	Asteraceae		NE	Range-restricted; Egypt, Iraq, Jordan, Kuwait, Palestine, Lebanon, Syria, Saudi Arabia	
Agathophora alopecuroides (Delile) Fenzl ex Bunge.	Amaranthaceae		NE	Widespread	
Alcea striata Alef.	Malvaceae		NE	Range-restricted; Egypt (Sinai), Israel, Jordan, Lebanon, Palestine, Saudi Arabia, Syria, Turkey	Rare in KSA

Alkanna orientalis (L.) Boiss.	Boraginaceae		NE	Widespread	
Anarrhinum orientale Benth.	Plantaginaceae		NE	Widespread	
Anastatica hierochuntica L.	Brassicaceae		NE	Widespread	
Anthemis deserti Boiss.	Asteraceae		NE	Range-restricted; Egypt, Iraq, Jordan, Lebanon, Palestine, Saudi Arabia	
Anvillea garcinii DC.	Asteraceae	Buphthalmum arabicum Delile	NE	Widespread	
Artemisia judaica L.	Asteraceae		NE	Widespread	
Artemisia sieberi Besser.	Asteraceae		NE	Widespread	
Asphodelus tenuifolius Cav.	Asphodelaceae		NE	Widespread	
Astragalus caprinus L.	Fabaceae		NE	Widespread	
Astragalus echinus DC.	Fabaceae		NE	Range-restricted; Egypt (Sinai), Lebanon, Saudi Arabia, Syria	Rare in KSA
Astragalus spinosus (Forssk.) Muschl.	Fabaceae		NE	Widespread	
Ballota undulata (Sieber ex Fresen.) Benth.	Lamiaceae	*Pseudodictamnus undulatus* (Benth.) Salmaki & Siadati	NE	Range-restricted; Egypt, Jordan, Palestine, Saudi Arabia, Syria	
Bromus tectorum L.	Poaceae		NE	Widespread	
Cakile arabica Velen.	Brassicaceae		NE	Range-restricted; Iran, Iraq, Kuwait, Saudi Arabia	
Calligonum comosum L'Hér.	Polygonaceae		NE	Widespread	
Caroxylon villosum (Schult.) Akhani & Roalson.	Amaranthaceae	*Salsola vermiculata* L., *Salsola villosa* Schult.	NE	Widespread	
Centaurea sinaica DC.	Asteraceae		NE	Range-restricted; Egypt, Israel, Jordan, Oman, Qatar, Saudi Arabia, United Arab Emirates	

Citrullus colocynthis (L.) Schrad.	Cucurbitaceae		NE	Widespread	
Cymbopogon schoenanthus (L.) Spreng.	Poaceae		NE	Widespread	
Daphne mucronata subsp. *linearifolia* (Hart) Halda.	Thymelaeaceae			Range-restricted; Israel, Jordan, Palestine, Saudi Arabia	Rare in KSA
Diplotaxis acris (Forssk.) Boiss.	Brassicaceae		NE	Widespread	
Diplotaxis harra Boiss.	Brassicaceae		NE	Widespread	
Dodonaea viscosa Jacq.	Sapindaceae		LC	Widespread	
Ducrosia flabellifolia Boiss.	Apiaceae		NE	Range-restricted; Iraq, Jordan, Saudi Arabia	Rare in KSA
Echinops glaberrimus DC.	Asteraceae		NE	Range-restricted; Egypt, Israel, Jordan, Saudi Arabia	
Ephedra alata Decne.	Ephedraceae		LC	Widespread	
Ephedra ciliata Fisch. & C.A.Mey.	Ephedraceae	*Ephedra ciliata* Fisch. & C.A.Mey. var. *ciliata*, *Ephedra foliata* Boiss. ex C.A.Mey., *Ephedra foliata* var. *ciliata* (Fisch. & C.A.Mey.) Stapf	LC	Widespread	
Ephedra pachyclada subsp. *sinaica* (Riedl) Freitag & Maier-St.	Ephedraceae	*Ephedra sinaica* Riedl	NE	Range-restricted; Egypt (Sinai), Jordan, Saudi Arabia, Yemen	Rare in KSA. It has only been recorded from one locality in AlUla.
Euryops jaberiana Abedin & Chaudhary.	Asteraceae		NT	National endemic	Populations in AlWard are large, of global importance.
Fagonia bruguieri DC.	Zygophyllaceae	*Zygophyllum bruguieri* (DC.) Christenh. & Byng	NE	Widespread	
Fagonia glutinosa Delile.	Zygophyllaceae	*Zygophyllum glutinosum* (Delile) Christenh. & Byng	NE	Widespread	

Fagonia mollis Delile.	Zygophyllaceae	*Zygophyllum molle* (Delile) Christenh. & Byng	NE	Range-restricted; Egypt (Sinai), Israel, Jordan, Palestine, Saudi Arabia, Syria.	
Fagonia paulayana J.Wagner & Vierh.	Zygophyllaceae	*Zygophyllum paulayanum* (J. Wagner & Vierh.) Christenh. & Byng	NE	Widespread	
Farsetia aegyptia Turra.	Brassicaceae		NE	Widespread	
Farsetia burtonae Oliv.	Brassicaceae		NE	Range restricted, Iraq, Kuwait, Saudi Arabia	
Farsetia longisiliqua Decne.	Brassicaceae	*Farsetia stylosa* T.Anderson	NE	Widespread	
Ferula sinaica Boiss.	Apiaceae		NE	Range-restricted; Egypt (Sinai), Israel, Jordan, Palestine, Saudi Arabia	Restricted distribution in KSA
Ficus palmata Forssk.	Moraceae		LC (Arabian Peninsula)	Widespread	
Glaucium arabicum Fresen.	Papaveraceae		NE	Range restricted; Egypt (Sinai), Israel, Iraq, Lebanon, Syria, Palestine, Saudi Arabia	Rare in KSA.
Gymnocarpos decander Forssk.	Caryophyllaceae		NE	Widespread	
Gypsophila capillaris (Forssk.) C.Chr.	Caryophyllaceae		NE	Widespread	
Haloxylon salicornicum (Moq.) Bunge ex Boiss.	Amaranthaceae		NE	Widespread	
Helianthemum lippii (L.) Dum.Cours.	Cistaceae		NE	Widespread	
Heliotropium digynum (Forssk.) Asch. ex C.Chr.	Boraginaceae		NE	Widespread	

Hyoscyamus pseudoalbus E.K. Harvey, A.Abdulkareem & T.Särkinen.	Solanaceae			National Endemic	National Endemic
Hyoscyamus viscosus E.K. Harvey & A.Abdulkareem.	Solanaceae			National Endemic	National Endemic
Iphiona scabra DC. ex Decne.	Asteraceae		NE	Widespread	
Kickxia aegyptiaca Nábelek.	Plantaginaceae		NE	Widespread	
Kickxia pseudoscoparia V.A.W.Sm & D.A.Sutton.	Plantaginaceae		DD	Range-restricted; Egypt (Sinai), Palestine, Saudi Arabia, Sudan-South Sudan. This species was assessed as a Saudi Arabia endemic in Forrest & Neale (2023). Records exist for other countries but these require verification following taxonomic study	
Launaea mucronata (Forssk.) Muschl.	Asteraceae		NE	Widespread	
Lavandula coronopifolia Poir.	Lamiaceae		NE	Widespread	
Leysera leyseroides Maire.	Asteraceae	.	NE	Widespread	
Lycium shawii Roem. & Schult.	Solanaceae		LC	Widespread	
Medicago laciniata (L.) Mill.	Fabaceae		NE	Widespread	
Monsonia nivea Webb.	Geraniaceae		NE	Widespread	
Morettia parviflora Boiss.	Brassicaceae		NE	Range-restricted; Bahrain, Egypt (Sinai), Israel, Jordan, Oman, Palestine, Saudi Arabia, Yemen, United Arab Emirates	

Nanorrhinum acerbianum (Boiss.) Betsche.	Plantaginaceae		NE	Widespread	
Nepeta sheilae Hedge & R.A.King.	Lamiaceae		DD	National endemic	National endemic
Neurada procumbens L.	Neuradaceae		NE	Widespread	
Noaea mucronata (Forssk.) Asch. & Schweinf.	Amaranthaceae		NE	Widespread	
Ochradenus baccatus Delile.	Resedaceae		NE	Widespread	
Pallenis hierochuntica (Michon) Greuter.	Asteraceae		NE	Widespread	
Panicum turgidum Forssk.	Poaceae		NE	Widespread	
Periploca aphylla Decne.	Apocynaceae		LC	Widespread	
Phlomis brachyodon (Boiss.) Zohary ex Rech.f.	Lamiaceae		NE	Range-restricted; Jordan, Palestine, Saudi Arabia	Rare in KSA
Pistacia khinjuk Stocks.	Anacardiaceae		LC (Arabian Peninsula)	Widespread	
Plantago afra L.	Plantaginaceae		NE	Widespread	
Plantago ovata Forssk.	Plantaginaceae		NE	Widespread	
Polycarpaea repens Asch. & Schweinf. ex Asch.	Caryophyllaceae		NE	Widespread	
Pterocephalus sanctus Decne.	Caprifoliaceae		NE	Range-restricted; Egypt (Sinai), Israel, Jordan, Palestine, Saudi Arabia	
Pulicaria undulata (L.) C.A.Mey. subsp. *Undulata.*	Asteraceae		NE	Widespread	
Ramaliella intricata (Boiss.) Zaika, Sukhor. & N.Kilian.	Asteraceae		NE	Range-restricted; Iran, Palestine, Saudi Arabia	Rare in KSA
Retama raetam (Forssk.) Webb & Berthel.	Fabaceae		NE	Widespread	

Rhanterium epapposum Oliv.	Asteraceae		NE	Widespread	
Rumex vesicarius L.	Polygonaceae		NE	Widespread	
Sageretia thea (Osbeck) M.C.Johnst.	Rhamnaceae		NE	Widespread	
Salvia deserti Decne.	Lamiaceae		NE	Range-restricted; Egypt (Sinai), Jordan, Israel, Palestine, Saudi Arabia	
Schismus barbatus (L.) Thell.	Poaceae		NE	Widespread	
Schouwia purpurea (Forssk.) Schweinf.	Brassicaceae		NE	Widespread	
Scrophularia deserti Delile.	Scrophulariaceae		NE	Widespread	
Scrophularia hypericifolia Wydler.	Scrophulariaceae	*Scrophularia syriaca* Benth.	NE	Widespread	
Senecio flavus (Decne.) Sch.Bip.	Asteraceae		NE	Widespread	
Silene arabica Boiss.	Caryophyllaceae		NE	Widespread	
Stachys aegyptiaca Pers.	Lamiaceae		NE	Range-restricted; Egypt (Sinai), Israel, Jordan, Palestine, Saudi Arabia	
Stipagrostis ciliata (Desf.) De Winter.	Poaceae		NE	Widespread	
Stipagrostis plumosa (L.) Munro ex T.Anderson.	Poaceae		NE	Widespread	
Stipellula capensis (Thunb.) Röser & Hamasha.	Poaceae	*Stipa capensis* Thunb.	NE	Widespread	
Teucrium polium L.	Lamiaceae		NE	Widespread	
Thymbra nabateorum (Danin & Hedge) Bräuchler.	Lamiaceae	*Satureja nabateorum* Danin & Hedge	E	Range-restricted; Jordan, Saudi Arabia	Threatened species - Abdulkarem et al, 2025

Trichodesma boissieri Post.	Boraginaceae		NE	Range-restricted; Jordan, Israel, Palestine, Saudi Arabia, Yemen	Rare in KSA
Trigonella stellata Forssk.	Fabaceae		NE	Widespread	
Vachellia gerrardi var. *najdensis* (Chaudhary) Ragup., Seigler, Ebinger & Maslin.		*Acacia gerrardi* Benth. subsp. *gerrardi*, *Acacia gerrardi* subsp. *negevensis* Zohary, *Acacia gerrardi* var. *najdensis* Chaudhary, *Acacia gerrardi* var. *negevensis*, *Vachellia gerrardi* (Benth.) P.J.H.Hurter subsp. *gerrardi*, *Vachellia gerrardi* subsp. *negevensis* (Zohary) Ragup., Seigler, Ebinger & Maslin	NE	Range-restricted; Iraq, Kuwait, Oman, Palestine, Saudi Arabia, Sinai, Yemen	
Vachellia oerfota (Forssk.) Kyal. & Boatwr.	Fabaceae	*Acacia oerfota* (Forssk.) Schweinf.	LC (Arabian Peninsula)	Widespread	
Vachellia tortilis (Forssk.) Galasso & Banfi.	Fabaceae	*Acacia tortilis* (Forssk.) Hayne	LC Global and regional		
Vachellia tortilis subsp. *raddiana* (Savi) Kyal. & Boatwr.	Fabaceae	*Acacia raddiana* Savi, *Acacia tortilis* subsp. *raddiana* (Savi) Brenan	NE	Widespread	
Vachellia tortilis (Forssk.) Galasso & Banfi subsp. *Tortilis.*	Fabaceae		NE	Widespread	
Verbascum shiqricum Hemaid.	Scrophulariaceae		VUD2	National endemic	National endemic, threatened
Withania somnifera (L.) Dunal.	Solanaceae		NE	Widespread	
Zilla spinosa (L.) Prantl.	Brassicaceae		NE	Widespread	
Zoegea purpurea Fresen.	Asteraceae		NE	Widespread	

APPENDIX 2

FAUNA NAME

List of fauna used in the manual. Fauna classed as of high conservation value is highlighted. The list comprises the class, order, family, species name and common name. For each species, it is indicated if it is endemic (End) to the Arabian Peninsula or near endemic (NE – defined as >75% of the global range occurring within AlUla), geographically restricted (G.R. – i.e., species with very constrained area of occupancy or extent of occurrence). The regional IUCN status is also provided. Conservation status categories abbreviations:

- **CR** – Critically Endangered
- **EN** – Endangered
- **VU** – Vulnerable
- **NT** – Near Threatened
- **LC** – Least Concern
- **DD** – Data Deficient
- **NA** – Not Applicable
- **NE** – Not Evaluated

CLASS	ORDER	FAMILY	SPECIES	COMMON NAME	END	G.R.	IUCN
Amphibia	Anura	Bufonidae	*Bufotes sitibundus*	Variable green toad	-	-	CR
Amphibia	Anura	Bufonidae	*Sclerophrys arabica*	Arabian toad	Yes	-	LC
Amphibia	Anura	Bufonidae	*Duttaphrynus dhufarensis*	Oman toad	Yes	-	VU
Amphibia	Anura	Dicroglossidae	*Euphlyctis ehrenbergii*	Arabian five-fingered frog	Yes	-	CR
Arachnida	Araneae	Araneidae	*Larinia chloris*	Slender orb-weaver spider	-	-	DD
Arachnida	Araneae	Gnaphosidae	*Zelotes sp.*	Ground spider	-	-	NE
Arachnida	Araneae	Lycosidae	*Hogna sp.*	Ferocious wolf spider	-	-	NE
Arachnida	Araneae	Lycosidae	*Lycosa piochardi*	Tarantula wolf spider	-	-	LC
Arachnida	Araneae	Oecobiidae	*Oecobius sp.*	Wall spider	-	-	NE

Arachnida	Araneae	Oecobiidae	*Uroctea cf. thaleri*	Bordered disc web spider	-	-	LC
Arachnida	Araneae	Palpimanidae	*Palpimanus gibbulus*	Common palp-footed spider	-	-	LC
Arachnida	Araneae	Philodromidae	*Thanatus cf. setiger*	False crab spider	-	-	LC
Arachnida	Araneae	Pholcidae	*Artema nephilit*	Giant daddy-long-leg spider	-	-	LC
Arachnida	Araneae	Pholcidae	*Holocnemus pluchei*	Marbled daddy long-legs spider	-	Yes	LC
Arachnida	Araneae	Salticidae	*Thyene imperialis*	Jumping spider	-	-	LC
Arachnida	Araneae	Selenopidae	*Selenops radiatus*	Palm wall crab spider	-	-	LC
Arachnida	Araneae	Theridiidae	*Latrodectus revivensis*	Desert widow spider	-	-	DD
Arachnida	Araneae	Theridiidae	*Steatoda cf. latifasciata*	False widow spider	-	-	DD
Arachnida	Araneae	Theridiidae	*Steatoda cf. paykulliana*	False widow spider	-	-	DD
Arachnida	Scorpiones	Buthidae	*Buthacus yotvatensis*	Yotvata sand scorpion	-	-	LC
Arachnida	Scorpiones	Scorpionidae	*Scorpio fuscus*	Dark large-clawed scorpion	-	-	LC
Aves	Accipitriformes	Accipitridae	*Aquila chrysaetos*	Golden Eagle	-	-	CR
Aves	Accipitriformes	Accipitridae	*Aquila fasciata*	Bonelli's Eagle	-	-	EN
Aves	Accipitriformes	Accipitridae	*Aquila verreauxii*	Verreaux's Eagle	-	-	CR
Aves	Accipitriformes	Accipitridae	*Buteo buteo*	Steppe Buzzard	-	-	NE
Aves	Accipitriformes	Accipitridae	*Buteo rufinus*	Long-legged Buzzard	-	-	EN
Aves	Accipitriformes	Accipitridae	*Circaetus gallicus*	Short-toed Snake-eagle	-	-	EN
Aves	Accipitriformes	Accipitridae	*Circus aeruginosus*	Western Marsh-harrier	-	-	VU
Aves	Accipitriformes	Accipitridae	*Torgos tracheliotos*	Lappet-faced Vulture	-	-	CR
Aves	Apodiformes	Apodidae	*Apus apus*	Common Swift	-	Yes	NE
Aves	Caprimulgiformes	Caprimulgidae	*Caprimulgus nubicus*	Nubian Nightjar	-	-	VU
Aves	Charadriiformes	Glareolidae	*Cursorius cursor*	Cream-coloured Courser	-	-	LC

Aves	Columbiformes	Columbidae	*Streptopelia turtur*	European Turtle-dove	-	Yes	NT
Aves	Falconiformes	Falconidae	*Falco concolor*	Sooty Falcon	-	-	CR
Aves	Falconiformes	Falconidae	*Falco peregrinus*	Peregrine Falcon/Barbary Falcon	-	-	EN
Aves	Galliformes	Phasianidae	*Alectoris chukar*	Chukar	-	-	LC
Aves	Galliformes	Phasianidae	*Coturnix coturnix*	Common Quail	-	-	LC
Aves	Passeriformes	Alaudidae	*Alaemon alaudipes*	Greater Hoopoe-lark	-	-	LC
Aves	Passeriformes	Alaudidae	*Ammomanes cinctura*	Bar-tailed Lark	-	Yes	LC
Aves	Passeriformes	Alaudidae	*Calandrella eremica*	Rufous-capped Lark	-	-	EN
Aves	Passeriformes	Alaudidae	*Eremalauda eremodites*	Arabian Lark	NE	-	LC
Aves	Passeriformes	Alaudidae	*Eremophila bilopha*	Temminck's Lark	-	-	LC
Aves	Passeriformes	Estrildidae	*Euodice cantans*	African Silverbill	-	-	LC
Aves	Passeriformes	Muscicapidae	*Monticola solitarius*	Blue Rock-thrush	-	-	LC
Aves	Passeriformes	Muscicapidae	*Oenanthe oenanthe*	Northern Wheatear	-	-	NE
Aves	Passeriformes	Muscicapidae	*Oenanthe xanthoprymna*	Kurdish Wheatear	-	Yes	NT
Aves	Passeriformes	Muscicapidae	*Phoenicurus ochruros*	Black Redstart	-	-	LC
Aves	Passeriformes	Ploceidae	*Ploceus galbula*	Rüppell's Weaver	-	-	NA
Aves	Passeriformes	Pycnonotidae	*Pycnonotus leucotis*	White-eared Bulbul	-	-	NA
Aves	Passeriformes	Sylviidae	*Curruca leucomelaena*	Arabian Warbler	-	-	LC
Aves	Passeriformes	Sylviidae	*Curruca melanocephala*	Sardinian Warbler	-	-	VU
Aves	Passeriformes	Sylviidae	*Curruca nana*	Asian Desert Warbler	-	-	LC
Aves	Passeriformes	Sylviidae	*Sylvia borin*	Garden Warbler	-	-	NE
Aves	Strigiformes	Strigidae	*Bubo ascalaphus*	Pharaoh Eagle-owl	-	-	VU
Aves	Strigiformes	Strigidae	*Otus brucei*	Pallid Scops-owl	-	Yes	CR

Insecta	Lepidoptera	Erebidae	*Anumeta spilota*	-	-	-	NE
Insecta	Lepidoptera	Erebidae	*Casama innotata*	-	-	-	NE
Insecta	Lepidoptera	Erebidae	*Drasteria flexuosa*	-	-	-	NE
Insecta	Lepidoptera	Erebidae	*Gnamptonyx innexa*	-	-	Yes	NE
Insecta	Lepidoptera	Erebidae	*Hypotacha ochribasalis*	-	-	-	NE
Insecta	Lepidoptera	Erebidae	*Ophiusa tirhaca*	-	-	-	NE
Insecta	Lepidoptera	Erebidae	*Pandesma robusta*	-	-	Yes	NE
Insecta	Lepidoptera	Erebidae	*Tathorhynchus exsiccata*	-	-	-	NE
Insecta	Lepidoptera	Geometridae	*Orthonama obstipata*	-	-	-	NE
Insecta	Lepidoptera	Geometridae	*Zamarada minimaria*	-	-	-	NE
Insecta	Lepidoptera	Hesperiidae	*Gegenes nostrodamus*	Mediterranean skipper	-	-	DD
Insecta	Lepidoptera	Hesperiidae	*Pelopidas mathias*	Black-branded swift	-	-	DD
Insecta	Lepidoptera	Lasiocampidae	*Streblote acaciae*	-	-	-	NE
Insecta	Lepidoptera	Lycaenidae	*Brephidium exilis*	Western pygmy blue	-	-	NA
Insecta	Lepidoptera	Lycaenidae	*Freyeria trochylus*	Grass jewel	-	-	DD
Insecta	Lepidoptera	Lycaenidae	*Leptotes pirithous*	Lang's short-tailed blue	-	-	LC
Insecta	Lepidoptera	Lycaenidae	*Zizeeria karsandra*	Dark grass blue	-	-	DD
Insecta	Lepidoptera	Noctuidae	*Agrotis ipsilon*	-	-	Yes	NE
Insecta	Lepidoptera	Noctuidae	*Agrotis segetum*	-	-	-	NE
Insecta	Lepidoptera	Noctuidae	*Hecatera dysodea*	-	-	-	NE
Insecta	Lepidoptera	Noctuidae	*Helicoverpa armigera*	-	-	Yes	NE
Insecta	Lepidoptera	Noctuidae	*Heliothis nubigera*	-	-	Yes	NE
Insecta	Lepidoptera	Nymphalidae	*Junonia hierta*	Yellow pansy	-	Yes	LC

Insecta	Lepidoptera	Nymphalidae	*Junonia orithya*	Blue pansy	-	Yes	LC
Insecta	Lepidoptera	Pieridae	*Colotis chrysonome*	Golden arab	-	Yes	LC
Insecta	Lepidoptera	Pieridae	*Colotis danae*	Crimson tip	-	-	LC
Insecta	Lepidoptera	Pieridae	*Colotis halimede*	Yellow patch white	-	-	DD
Insecta	Lepidoptera	Pieridae	*Colotis liagore*	Desert orange tip	-	-	LC
Insecta	Lepidoptera	Pieridae	*Euchloe belemia*	Green-striped white	-	-	DD
Insecta	Lepidoptera	Sphingidae	*Daphnis nerii*	-	-	-	NE
Insecta	Lepidoptera	Sphingidae	*Hyles livornica*	-	-	Yes	NE
Insecta	Odonata	Libellulidae	*Sympetrum fonscolombii*	Red-veined darter	-	-	LC
Mammalia	Artiodactyla	Bovidae	*Capra nubiana*	Nubian ibex	-	Yes	EN
Mammalia	Artiodactyla	Bovidae	*Gazella arabica*	Arabian gazelle	Yes	-	EN
Mammalia	Artiodactyla	Bovidae	*Oryx leucoryx*	Arabian oryx	Yes	-	EN
Mammalia	Carnivora	Canidae	*Canis lupus*	Grey wolf	-	-	EN
Mammalia	Carnivora	Canidae	*Vulpes cana*	Blanford's fox	-	-	NT
Mammalia	Carnivora	Felidae	*Felis lybica*	Afro-Asiatic wildcat	-	-	NT
Mammalia	Chiroptera	Pteropodidae	*Rousettus aegyptiacus*	Egyptian rousette	-	Yes	LC
Mammalia	Chiroptera	Rhinopomatidae	*Rhinopoma cystops*	Arabian mouse-tailed bat	-	-	LC
Mammalia	Chiroptera	Vespertilionidae	*Barbastella leucomelas*	Eastern barbastelle	-	-	VU
Mammalia	Chiroptera	Vespertilionidae	*Hypsugo ariel*	Fairy pipistrelle	-	-	NT
Mammalia	Chiroptera	Vespertilionidae	*Pipistrellus kuhlii*	Kuhl's pipistrelle	-	Yes	LC
Mammalia	Chiroptera	Vespertilionidae	*Plecotus christii*	Christie's big-eared bat	-	-	NT
Mammalia	Lagomorpha	Leporidae	*Lepus capensis*	Cape hare	-	-	NT
Mammalia	Rodentia	Dipodidae	*Jaculus loftusi*	Arabian jerboa	NE	-	LC
Mammalia	Rodentia	Gliridae	*Eliomys melanurus*	Black-tailed garden dormouse	-	-	NT

Mammalia	Rodentia	Muridae	*Gerbillus cheesmani*	Cheesman's gerbil	Yes	-	LC
Mammalia	Rodentia	Muridae	*Gerbillus dasyurus*	Wagner's gerbil	NE	-	LC
Mammalia	Rodentia	Muridae	*Psammomys obesus*	Fat sand rat	-	Yes	LC
Reptilia	Squamata	Agamidae	*Pseudotrapelus sinaitus*	Sinai agama	-	-	LC
Reptilia	Squamata	Agamidae	*Uromastyx aegyptia*	Egyptian mastigure	-	-	NT
Reptilia	Squamata	Agamidae	*Uromastyx ornata*	Ornate mastigure	-	-	NT
Reptilia	Squamata	Colubridae	*Lytorhynchus diadema*	Crowned leafnose snake	-	-	LC
Reptilia	Squamata	Colubridae	*Platyceps elegantissimus*	Elegant racer	-	-	LC
Reptilia	Squamata	Colubridae	*Platyceps saharicus*	Saharan racer	-	Yes	LC
Reptilia	Squamata	Colubridae	*Spalerosophis diadema*	Diadem snake	-	-	LC
Reptilia	Squamata	Colubridae	*Telescopus dhara*	Arabian cat snake	-	Yes	DD
Reptilia	Squamata	Gekkonidae	*Hemidactylus granosus*	Grainy house gecko	-	-	LC
Reptilia	Squamata	Gekkonidae	*Stenodactylus doriae*	Dune sand gecko	-	-	LC
Reptilia	Squamata	Gekkonidae	*Tropiocolotes yomtovi*	Yom-Tov's sand gecko	-	-	LC
Reptilia	Squamata	Lacertidae	*Acanthodactylus boskianus*	Bosk's fringe-fingered lizard			LC
Reptilia	Squamata	Lacertidae	*Acanthodactylus schmidti*	Schmidt's fringe-fingered lizard	-	-	LC
Reptilia	Squamata	Lacertidae	*Acanthodactylus tilburyi*	Tilbury's fringe-fingered lizard	-	-	DD
Reptilia	Squamata	Phyllodactylidae	*Ptyodactylus ananjevae*	Ananjeva's fan-fingered gecko	-	-	LC
Reptilia	Squamata	Psammophiidae	*Psammophis schokari*	Schokari sand racer	-	-	LC
Reptilia	Squamata	Scincidae	*Chalcides ocellatus*	Ocellated bronze skink	-	-	LC
Reptilia	Squamata	Scincidae	*Scincus conirostris*	Sandfish skink	-	-	LC
Reptilia	Squamata	Varanidae	*Varanus griseus*	Desert monitor	-	-	LC
Reptilia	Squamata	Viperidae	*Cerastes gasperettii*	Gasperetti's viper	-	-	LC

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THE HABITATS OF ALULA

AlUla County encompasses an exceptional diversity of arid landscapes, shaped over time by the interplay of geology, climate and human land use. From volcanic plateaux and sandstone formations to mountains, wadis, sandy plains and dunes, these landscapes support a rich mosaic of habitats with their associated plant and animal communities.

Developed by the French Agency for AlUla Development (AFALULA) and the Royal Commission for AlUla (RCU), together with their scientific partners, this Field Guide presents the standardised habitat classification framework established for AlUla County.

Drawing on several years of ecological research, field surveys and spatial analysis, the classification brings together knowledge of AlUla's vegetation, flora, fauna, soils and physical environment within a coherent ecological framework.

Designed as a practical companion for the field, the guide supports the identification and interpretation of AlUla's principal habitats and provides a shared ecological reference for scientists, conservation practitioners, land managers, planners and environmental specialists.

By strengthening our understanding of AlUla's landscapes and the biodiversity they sustain, the guide contributes to a common foundation for their conservation, restoration and long-term stewardship.

