Diwan of Royal Court
The National Field Research Centre for
Environmental Conservation

The Arabian Tahr

a journey through the Hajar Mountains

HIS MAJESTY SULTAN QABOOS BIN SAID

Foreword by HE Sayyed
Chairman of the Board

Each environment has its unique characteristics which make it looks different from others. The common factor between all ecosystems is the need of human beings for their environment and their interaction with it. The environment has always been an economic source to the people who live in it. Therefore, people have exploited its resources without paying attention to the damage that they may be causing as a result of this excessive exhaustion of resources. Modernity, with its economic and technological developments, has rapidly contributed to the enervation of the environment. Accordingly, serious calls are emerging emphasizing the importance of protection and conservation of the environment. This concept has been deeply rooted in the culture of the people of the Sultanate of Oman since the early days of the Omani Renaissance under the wise leadership of His Majesty Sultan Qaboos bin Said. His Majesty the Sultan has interpreted this concept into actions and programs through the establishment of many corporations and institutions which care for the conservation of the environment and the protection of the environmental heritage of the Sultanate of Oman to ensure its sustainability and consolidation for the sake of future generations.

The care and attention which His Majesty has always paid to the environment has resulted, at the international level, in establishing the Sultan Qaboos Prize for Environmental Preservation which is sponsored by the United Nations Educational, Scientific and Cultural Organization (UNESCO). This award confirms the concept of globalization of environmental issues and calls for collaboration of all possible efforts to preserve environment resources.

Oman National Centre for Field Research on Environment Conservation is another remarkable endeavor in the realization of the concept of environment conservation. This center contributes, through its well programmed field researches, to the exploration of the components of the Omani environment. Thus, it integrates its role with other efforts in this regard.

The Omani environment is distinguished by its infrequent vegetation and animals. The Arabian tahr is one of these rare animals which live in Oman. They belong to the family "Caprinae". In the past, tahr were considered as food resource since they were found in large numbers in the Hajar Mountains. Hunting for food steadily resulted in a dramatic decrease of their numbers and a need for active conservation.

This book is a descriptive pictorial account of the life of these rare animals in their geographical environment as well its is considered the first specialized scientific publication from the centre. It reflects the care that the Sultanate of Oman gives to the conservation of the Omani environment as an interpretation of care and concern given by His Majesty the Sultan to this great national heritage.

Khalid bin Hilal Al Busaidi
Minister of Diwan of Royal Court
Chairman of the Board of Directors of
the National Field Research Centre for
Environmental Conservation

A message from the National Field Research Centre for Environmental Conservation

The National Field Research Centre for Environmental Conservation endeavors, within the framework of its terms of reference, to activate the role of field researchof the Omani environment which is very rich in biological diversity. Our environment is distinguished by rare plants and animals which are only found in the Sultanate of Oman. Since its establishment, the National Centre has devoted itself to the realisation of the wise vision of His Majesty Sultan Qaboos bin Said, aiming to stop the degradation of the Omani environment. His Majesty's wise vision also aims at achieving environmental sustainability through highlighting its components and accurately studying its elements via fieldwork and site research.

The efforts made by the staff in charge of Wadi As Sareen Nature Reserve , where the Arabian tahr has been protected for years, has resulted in tahr being able to live and breed in their habitat in isolation from human disturbances. To complement to these efforts, field research conducted under the supervision of the National Center, has uncovered new information related to their behavior, breeding and interactions with their habitat. The research has supported the development of new conservation and monitoring methods of this endangered species. We are finding that scientific approaches based on facts provide a deeper and broad philosophy in dealing with endangered animals while preserving other important components of the ecosystem.

The publication of this book is considered as the first step in disemenating the findings of field studies on the Arabian tahr which include information and photographs. Camera traps are still operating in several locations to monitor their movements. In addition, experts and rangers are working in the field. We hope that readers shall find in this book useful information about the Arabian tahr, and that these animals shall remain present in the minds of people, as the tahr and other creatures are parts of the whole ecosystem in which we live in this fabulously bio-diverse country.

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Introduction

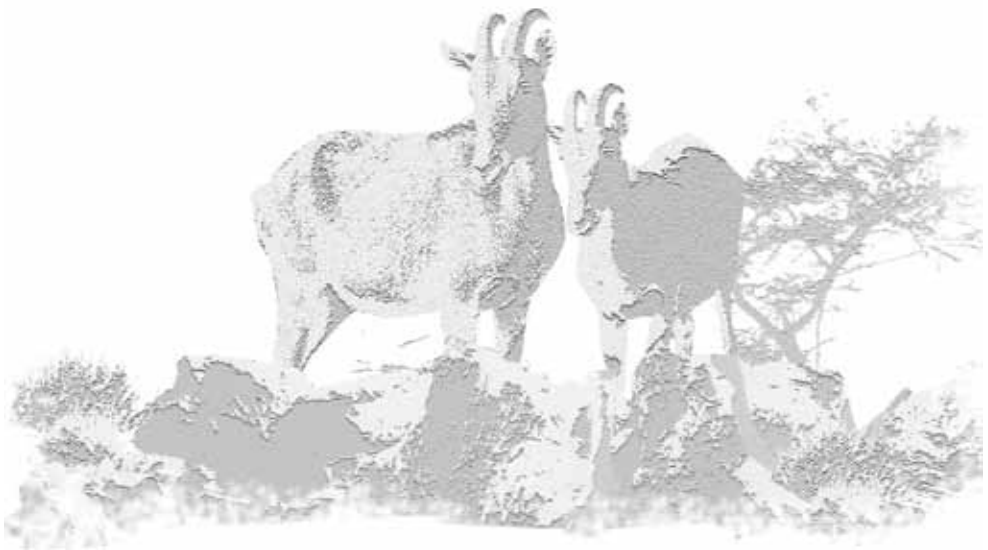
Few people know the Arabian tahr, even fewer know it well. Yet this small wild goat-like animal is an integral part of the Omani mountain landscape, found only on the stark steep cliffs of the Hajar Mountains. Over millennia the tahr has evolved and adapted to this unique ecosystem, rising to the challenges of the extreme climate and dramatic topography, forging a place for itself within the wildlife community. Yet, sadly, this place is being lost as the tahr struggles to survive in the context of a rapidly changing world. The Arabian tahr is now an Endangered species.

Within these pages you will discover what we know of the genetic evolution of the Arabian tahr, where it is found, and how many there may be still left in the wild. We will explore the mountain ecosystem in which the Arabian tahr lives, the unique physical landscape and the coexisting plants and animals of the mountains. We will share what we have learnt about the Arabian tahr's physiology, biology and social system, and ponder some of the important questions we still hope to answer. Finally, we will examine the reasons behind the tahr's decline and, perhaps most importantly, look for solutions offered through legislation, protection, research, education and public awareness.

The leadership of Oman is wisely taking bold steps towards conserving this iconic species. In line with this goal, the National Field Research Centre for Environmental Conservation is piloting new conservation research and education programs to promote its conservation. As part of this program, this book and others that will follow, aim to inform the public and draw attention to the plight of the tahr.

CHAPTER 1
THE ARABIAN TAHR: AN INTRODUCTION

The towering wall of cliffs rises like a monument against the awakening sky. Save the faint echo of birdsong all is still, the mountains pervaded by a deep sense of peace. Despite their stark, unforgiving appearance these mountains do in fact shelter a myriad of life. But there is one creature who epitomises the Omani mountains like no other, one who belongs only here. Perched on the edge of the impossibly vertical cliff before us stands an Arabian tahr, gazing out across the chasm at her feet as if surveying her kingdom. The tahr tenses and leaps into the void, falling for a moment before she expertly bounces off a sidewall and lands, miraculously, at the base of the cliff. What is the Arabian tahr? Where is it found and to whom is it related? The answers to these questions can be found in the following pages of this book.



a female tahr

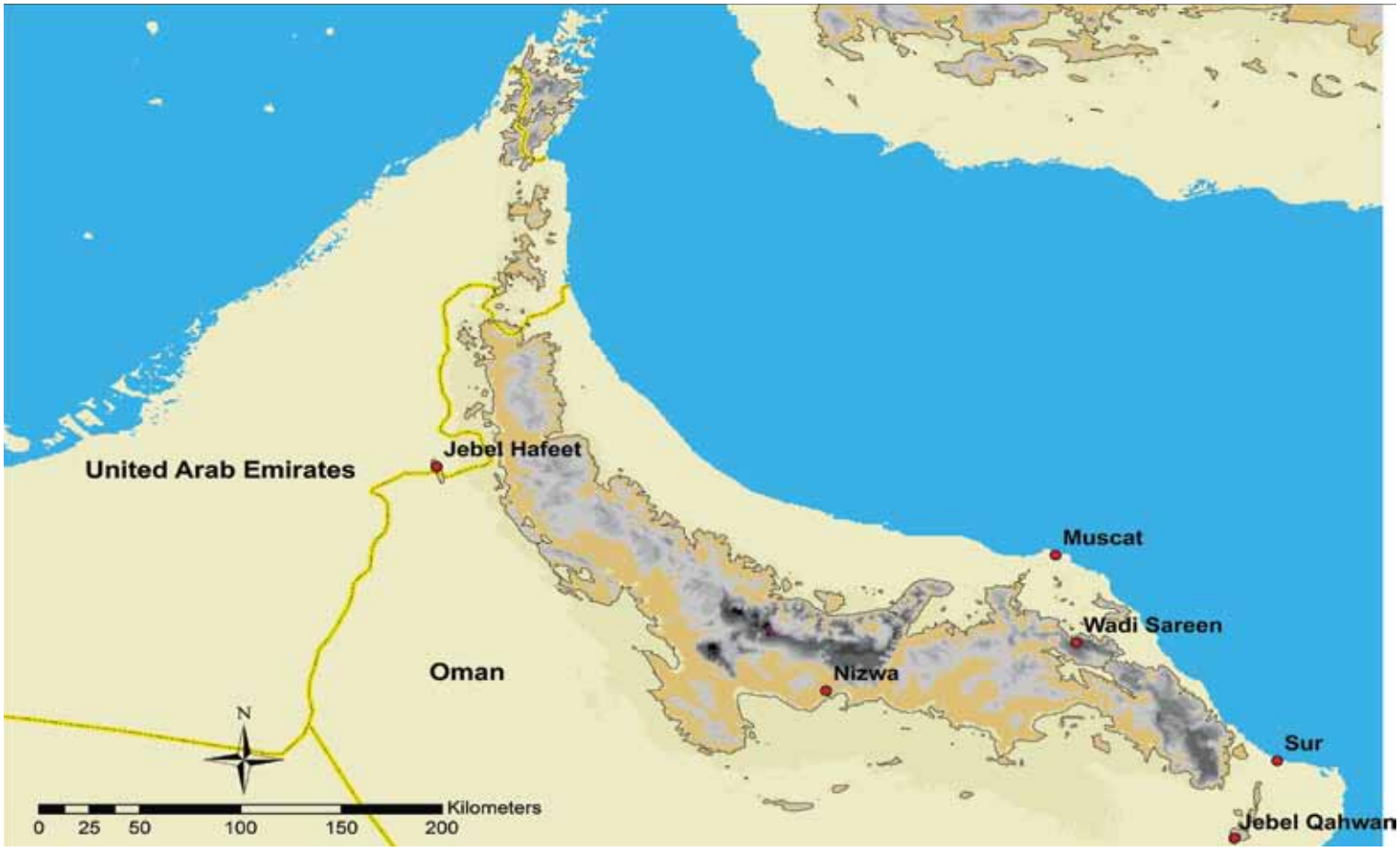
1.1 Physical description

The Arabian tahr is a muscular, stocky goat-like animal; males stand approximately 60cm at the shoulder and weigh about 35kg, while females are smaller and weigh approximately half as much. Males have a coarse, shaggy, often reddish coat in winter that becomes lighter and sleeker during summer. Older males grow a distinctive beard, long hair on the top half of their legs making them look like they are wearing socks and a dark mane which extends down their back. A white stripe runs from either side of the mouth to the forehead of both sexes, but the whole face often turns jet black in older males. Females have a similar coat but generally have less hair with no mane, leg ruffs, or beard. Both sexes have short horns, but the male's horns are much longer and wider than the female's. Both sexes have bare front knees probably due to their habit of kneeling on rocks to drink and eat.

a male tahr

1.2 The distribution of the Arabian tahr

The entire world population of the Arabian tahr is found only in the south-eastern corner of the Arabian Peninsula, in the northern mountains of Oman and the United Arab Emirates. The tahr once occurred throughout the 700km chain of Hajar Mountains, but are now limited to small scattered populations. Less than 5000 individuals are thought to remain in the wild, but in truth population estimates are uncertain due to the difficulty of surveying the population in their challenging mountain habitat. The largest population occurs in the Wadi Sareen Reserve near Muscat where they benefit from protection by rangers. Other important populations are located in Jebel Gamhah near Nakhl, in the Jebel Qahwan / Jebel Sabtah area in the Ja'alan and others may exist. In the Musandam peninsula in the north tahr are very rare and possibly extinct, they are only sporadically sighted in the Batinah region and we know of only one very small population on Jebel Hafit in the U.A.E.



Arabian tahr were historically distributed across the Hajar Mountains. Currently tahr occur in small scattered populations, the exact extent of which is unknown.

1.3 Genetics and evolution: is the Arabian tahr really a tahr?

Novel techniques are revolutionising our understanding of taxonomic relationships between many species. Whilst previously delineated on the basis of morphological characteristics and geographical distribution, taxonomists are now able to quantify the differences and similarities between species using genetics. Old relationships are being questioned and evolutionary pathways unravelled – and it now appears that the Arabian tahr's closest relatives may not actually be the other tahr.

Tahr are placed in the family Bovidae and the sub-family Caprinae – a group with 35 species of sheep, goats and their relatives found in mountainous regions across Europe, Asia, Africa and North America. The Caprinae diverged from their prehistoric relatives (Aegodontia) in the early Miocene, appearing in the Eurasian fossil record 15-18 million years ago. Though they were excluded from the lowlands by the dominance of prehistoric deer (Cervidae), Caprinae thrived in the mountains of Europe and Asia where they rapidly evolved. There are four Caprinae tribes; the Pantholopini (chiru), the Ovibovini (musk ox and takin), the Rupicaprini (gorals, serows and chamois) and Caprini (to which sheep, goats and tahr belong).

The Himalayan tahr, found from Northern India east to Bhutan.
Photograph by Robert Boesi

The Nilgiri tahr found in the western Ghats of Southern India. Photograph by Anilkumar

Historically the genus Hemitragus (the tahr) was distinguished from other goats on morphological grounds. Distinguishing features included their comparatively short horns set close together at their base which do not exceed the length of their head, and that the female's horns were only slightly smaller than the male's. The Hemitragus genus (tahr) included three species: the Arabian tahr, the Himalayan tahr (H. jemlahicus), found in the southern Himalaya from northern India east to Bhutan and north to Tibet, and the Nilgiri tahr (H. hylocrius), found in the Western Ghats of southern India.

Though the three species of tahr do look very similar, recent research has discovered that they evolved independently and are more distant relatives than first thought. Genetic analysis by researchers Ropiquet & Hassanin now shows that the Arabian tahr's closest relative is in fact the Aoudad (Ammotragus lervia), also known as the Barbary sheep. This genetic connection is

The Aoudad or Barbary sheep is thought to be the closest relative of the Arabian tahr. Photograph by Andres E. Rios-Saladana from Ungulata team-IREC Spain.

also supported by similar morphological characteristics and the geographic proximity of the two species. The two species have a similar coat colour, ruffs of hair on the upper forelegs and angular tufts of hair on the jaws. The Aoudad is native to North Africa, and like the Arabian tahr it inhabits rugged and mountainous terrain. The closest Arabian tahr and Aoudad populations are currently found approximately 2000km apart, separated by the Red Sea. Interestingly, genetic evidence places their common ancestor 4-7 million years ago at which time there was a land bridge joining southern Arabia and Africa, and it may have been the spreading of the Red Sea floor 4-5 million years ago which separated the two species.

As we continue to unravel the great mystery of evolution, the classification of the Caprinae may change yet again. For now our new understanding only heightens our appreciation of the uniqueness of the Arabian tahr.

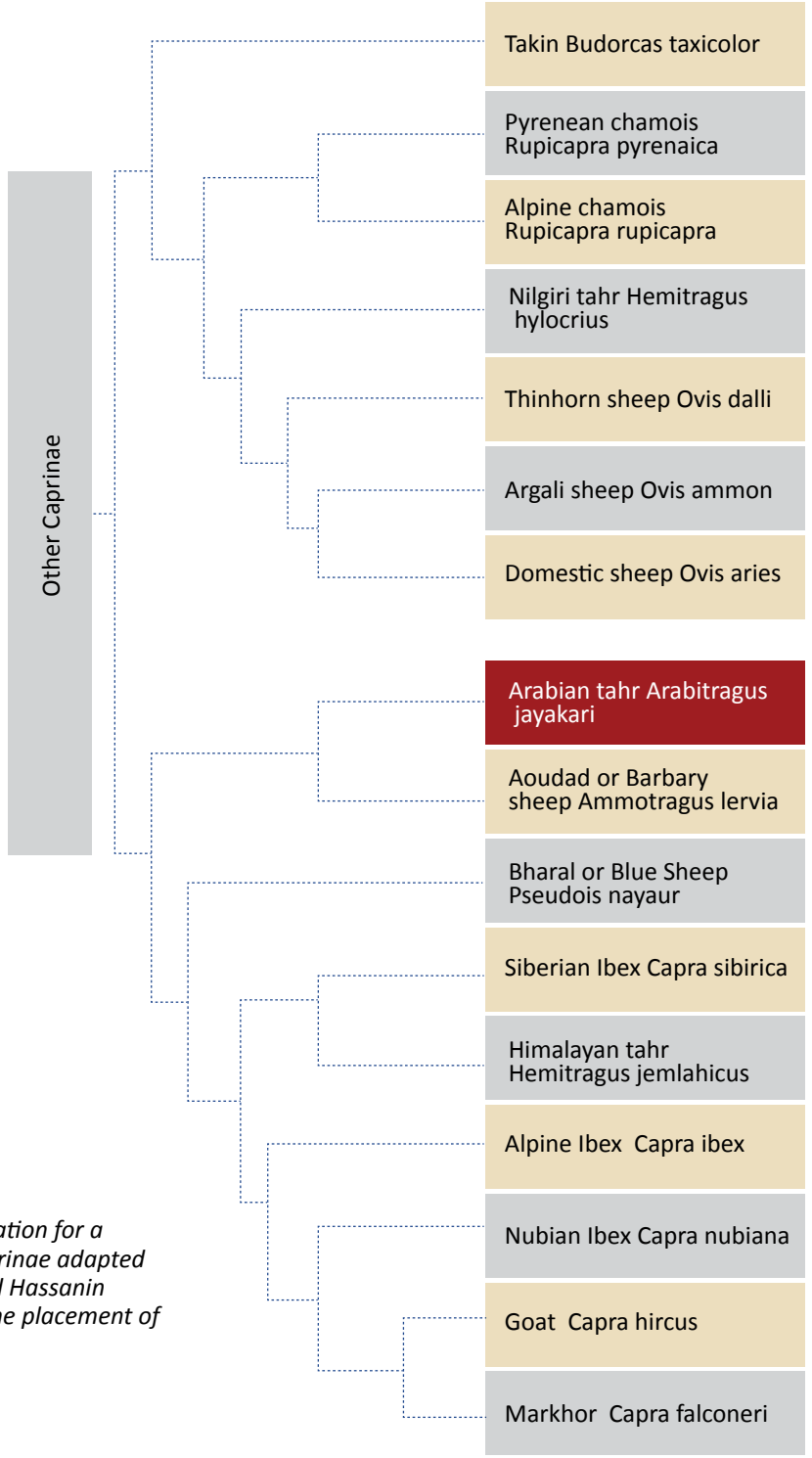


Figure 2. Classification for a portion of the Caprinae adapted from Ropiquet and Hassanin (2005), showing the placement of the Arabian tahr.

CHAPTER 2
THE HAJAR MOUNTAIN ECOSYSTEM

An ecosystem is a dynamic complex of the living and non-living interacting as a functional unit. Plant, animal, micro-organism, water, light, soil, rock, nutrient cycle and energy flow – an intricate entanglement that creates the diversity of our planet.

Mountain ecosystems are found on every continent, occupying approximately one fifth of the earth's surface, and are key centres of biological diversity for plants, wildlife and agriculture. Mountains play an important role in the water cycle and are essential sources of freshwater for many communities around the world.

The Arabian tahr lives in a mountain environment, dependent on the species and processes within the ecosystem. Some of the services the tahr needs are obvious, such as food and water. Some are more obscure - perhaps a predatory insect that prevents a disease outbreak, a bat that disperses the seed of a favoured plant, or another mammal that aids the cycling of nutrients within the system. Like other organisms, the tahr cannot live in isolation, but is part of this web of life.

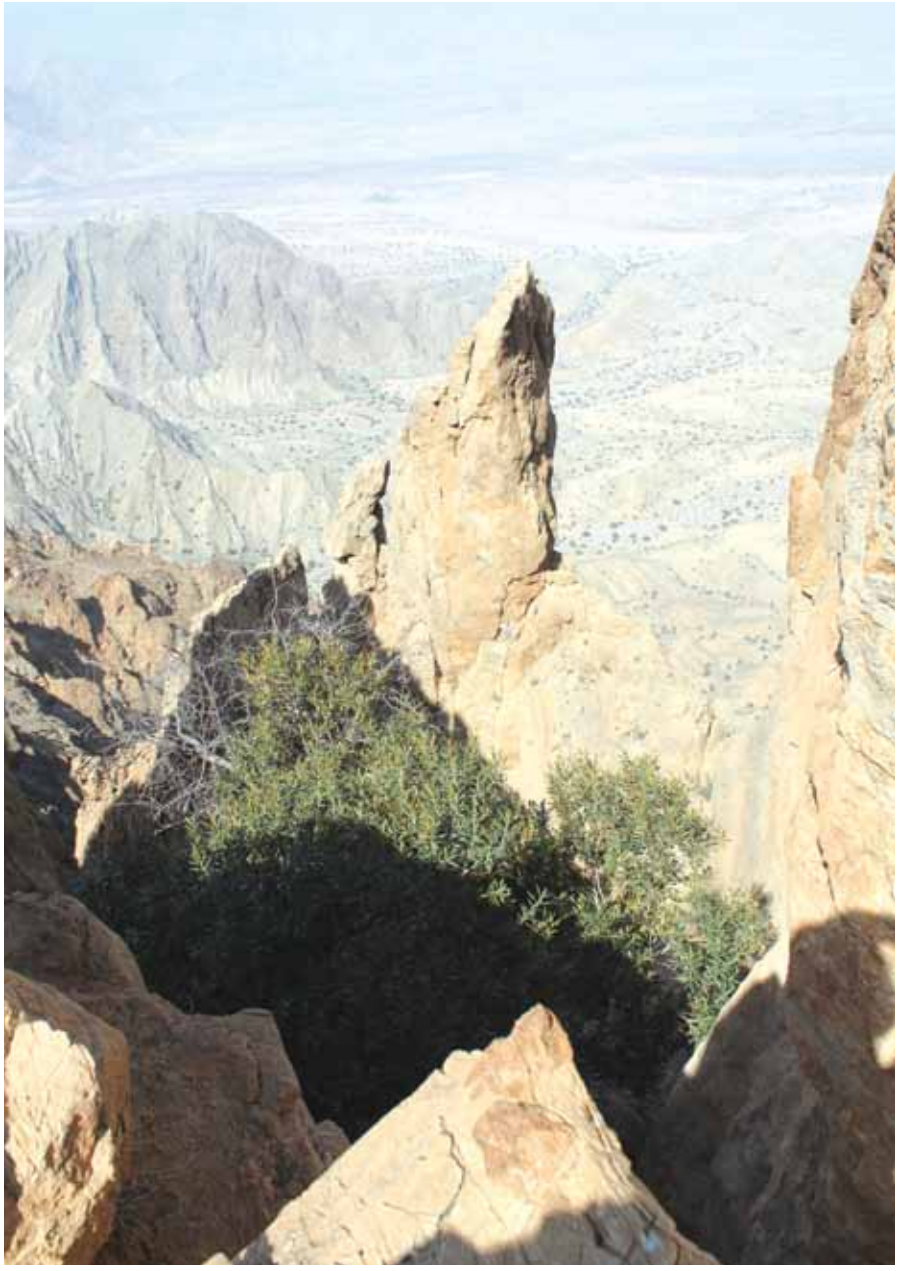
The twisted perpendicular rock beds on the plateau at 2000m in the Wadi Sareen reserve give us an appreciation of the forces that created the Hajars.

2.1 The Arabian tahr's mountain home

To understand the Arabian tahr we must begin by looking at its mountain home. The dramatic Hajar Mountains run 700 km from the Musandam peninsula in the north, southeast to the coast at Ras al Hadd, a high altitude apparition between the hot sandy interior and the sea. The mountains are bold and craggy, graced with broad high plateaus that end in sheer vertical cliffs slashed by deep snaking wadis. The range is split by the Samail gap into the western Hajar, Hajar al Gharbi, reaching just over 3000m at Jebel Shams, and the slightly lower Eastern Hajars, Hajar ash Sharqi.



Marine fossils attest to a time when the land was covered by a warm tropical sea.



Dramatic pinnacles near al Amerat.

The Hajar Mounains have a fascinating geological history. Oman sits on the north-eastern part of the Arabian plate. During the late Cretaceous period, approximately 90 million years ago, a large sea called the Tethys Ocean existed to the north of Oman, on top of the Asian plate. Movements caused the Arabian and Asian plates to begin pushing against each other, creating extreme pressure. When two plates collide in this way the denser oceanic plate usually slips below the lighter continental plate, but very occasionally the opposite can occur. In this case, the denser oceanic crust was pushed up over the lighter continental crust of the Arabian plate, producing a rare and unusual geological formation. Rocks that lay far far beneath the ocean were now beached on land; these rocks became known as the Samail ophiolite.

The meandering pathways of water imprint the landscape.

The Hajar Mountains were formed later during the Oligocene (some 40-50 million years ago) from these materials, when further tectonic activity related to the opening of the Red Sea and the collision of the Afro-Arabian and the Eurasian plate caused the area to squash, buckle and rise. Over the next 20 to 30 million years changes to the earth's climate exposed the mountains to a range of erosive forces, sculpting the landscape we see today. The nature of the different rock types and their response to erosion has determined the varied character of the Hajar Mountains. The highest peaks are composed of the denser resistant limestone, while the softer sedimentary rocks more prone to weathering are now found on lower ground. The dark dense crystalline rocks, of what was formerly oceanic crust (ophiolite), form lower but more jagged peaks as their crystals break up with weathering to create a highly irregular surface. The innumerable deep wadis that have been carved out of solid rock by fast flowing rivers and the many caves hollowed out by rainwater are legacies of wetter more tropical times.

The incredible erosive power of water is evident in this narrow canyon at Wadi Tanuf.

Just as rocks tell the story of the past, so too geology shapes the current environment. Drainage channels effectively trap moisture and nourish improbable plant life. Rainwater percolating through porous limestones and cracks in rock emerges as mountain springs and pools when it hits non-permeable rocks. Such springs provide a habitat for aquatic species, are indispensible water resources for many animals, such as the tahr, and have sustained the falaj system of agriculture for countless generations. At the same time, the sheer and impenetrable cliffs offer a unique habitat for the Arabian tahr and shield wildlife communities from encroachment and human settlement. In these rugged and breathtaking mountains, you cannot ignore the perpetuity of time, or the inextricable connection between life and land.

Caves in the mountains provide shelter for wildlife. Until very recently, caves were also used as homes by local people.

2.2 Climate

The generally hot arid climate of Oman is moderated in the mountains by increased rainfall and lower temperatures at altitude. Rainfall in the Hajars tends to be variable and patchy. It comes from three sources; winter rain from cold fronts, summer rains from thunderstorms and rain from cyclones. Winter rains typically fall between November and February, the result of cold fronts moving across the country from the north-east. Rain does also occasionally fall in summer, as moist south-west monsoon winds rise over the mountains. Finally, cyclones crossing the Indian Ocean can cause heavy rainfall in the mountains, though this does not occur every year. Though rainfall is sparse, sporadic and unpredictable, when rain does fall the response is immediate, with dry wadis transformed into raging torrents filled by water streaming down rock faces.

Generally, temperature drops by 6.5°C for every 1000m. Temperatures in the mountains are therefore considerably lower than at sea level. For instance, the average June maximum at Seeb, Muscat, is 40.4°C, but at Saiq, at an altitude of 1755m, it is only 27.6°C. Conversely the average January minimum is 17.3°C at Seeb, compared to 3.7°C at Saiq.

2.3 Flora

Plants create life from soil, carbon dioxide and water using energy from the sun, a link between the mountains and life itself. Plants are the food source of the Arabian tahr, and crucial in many ways to all mountain creatures.

Despite the aridity of the region and the ubiquity of bare rock, the Hajar Mountains support a surprisingly rich floral community. Nourished by relatively higher rainfall, more benign temperatures and numerous freshwater springs, vegetation flourishes along wadis and where slopes are gentle enough to allow soil to develop. Even on exposed cliff faces, plants cling along drainage cracks and in pockets of shade that provide welcome relief from the drying sun.

Like mountain ecosystems everywhere, the Hajars have high diversity and endemism. Approximately 300 species have been recorded, and roughly twenty-five of these are endemics, only found regionally or nationally. Past climates and geography influence the composition of the present day floral community; most species belong to the Asian floristic group and are similar to those found in SW Iran, Afghanistan and Baluchistan.

Water availability, topography and altitude are the most influential factors on vegetation abundance and diversity. Though the mountains receive higher rainfall, the capacity of the mostly rocky surface to absorb water is limited, so with even moderate rainfall runoff is high. Water pours across the slopes, cascades down cliffs and concentrates in wadis, where relatively lush vegetation develops. In many wadis groundwater lies close to the surface and remains accessible to plants. Fog drifting in from the ocean is also an important source of moisture.

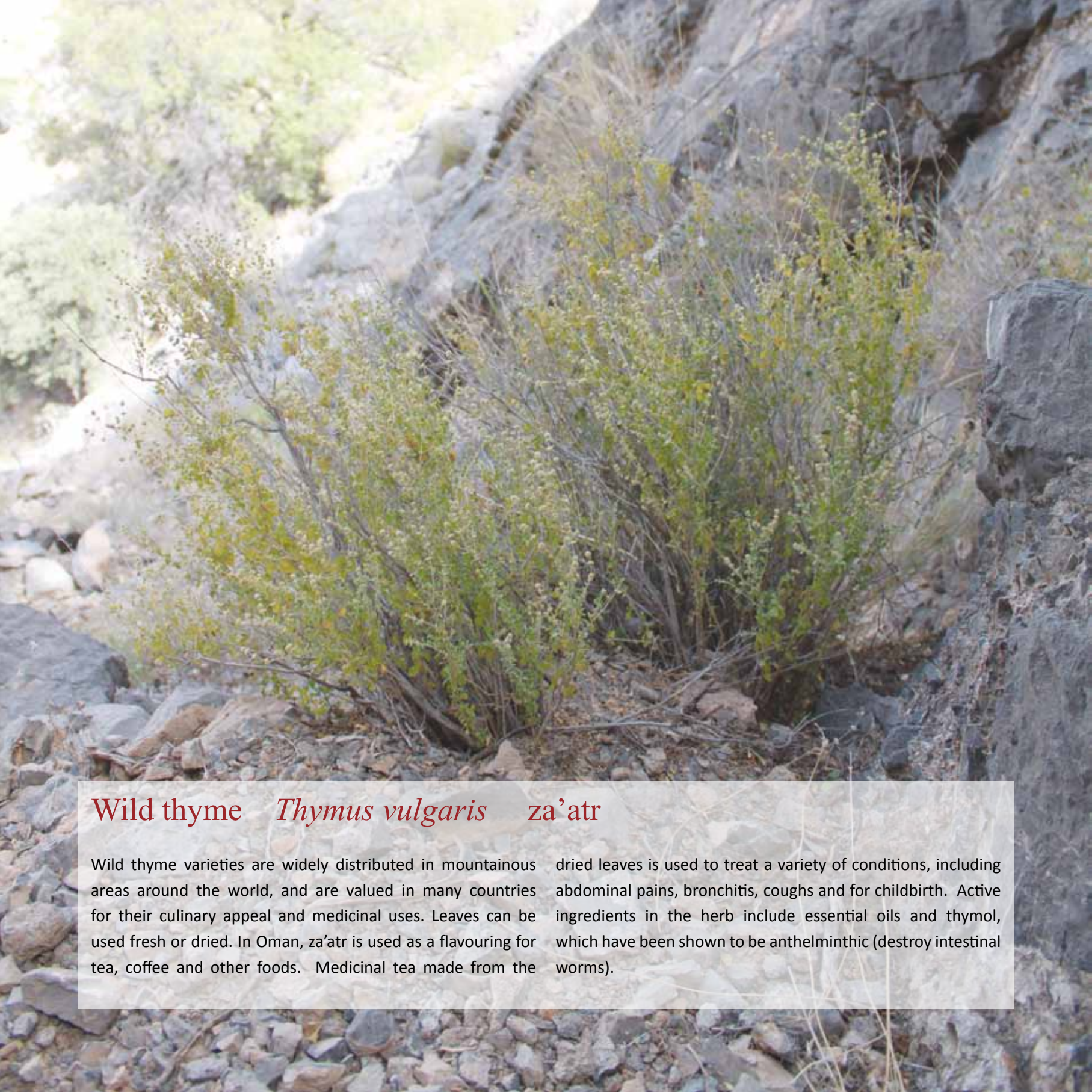
As with rainfall, temperatures in the mountains are more amicable than the often scorching lowlands. The difference in climate with increasing altitude results in changes in the numbers and types of plants as you move up the mountain. Botanical surveys have described four vegetation zones, with the greatest species richness found between 1000 and 1500m. Most likely taking advantage of greater plant diversity, the Arabian tahr can most often be found within this botanically rich zone.

While the general use of wild plants by people has declined considerably in recent years, the collection of wild fruits and herbs remains an important source of food and traditional medicine. Wild trees are also an important source of fodder for goats; young branches with fresh leaves are cut, or alternatively the tree is beaten with a stick and the fallen seed pods are collected.

On the following pages is a selection of flora species of the Hajar Mountains. Some are used directly by the Arabian tahr, while others are important simply because they contribute to the diversity and healthy functioning of the ecosystem.

Caralluma *Caralluma sp* dij

This highly valued succulent is found at altitudes from 1000 – 1900m. The plant stores water in its swollen stems and is able to reduce water loss to transpiration, allowing it to survive long periods without rain. Caralluma species are prescribed for a variety of ailments including diabetes and rheumatism, and as an antiseptic. Its efficacy for many traditional uses has been scientifically verified. In Oman, people often eat caralluma raw, simply by breaking off a small piece and eating the bitter tasting stem, or it may also be served with yogurt at home. In the west caralluma is marketed commercially as an appetite suppressant.



Wild thyme *Thymus vulgaris* za'atr

Wild thyme varieties are widely distributed in mountainous areas around the world, and are valued in many countries for their culinary appeal and medicinal uses. Leaves can be used fresh or dried. In Oman, za'atr is used as a flavouring for tea, coffee and other foods. Medicinal tea made from the dried leaves is used to treat a variety of conditions, including abdominal pains, bronchitis, coughs and for childbirth. Active ingredients in the herb include essential oils and thymol, which have been shown to be anthelminthic (destroy intestinal worms).

Christ's thorn *Ziziphus spina-christi* Sidr

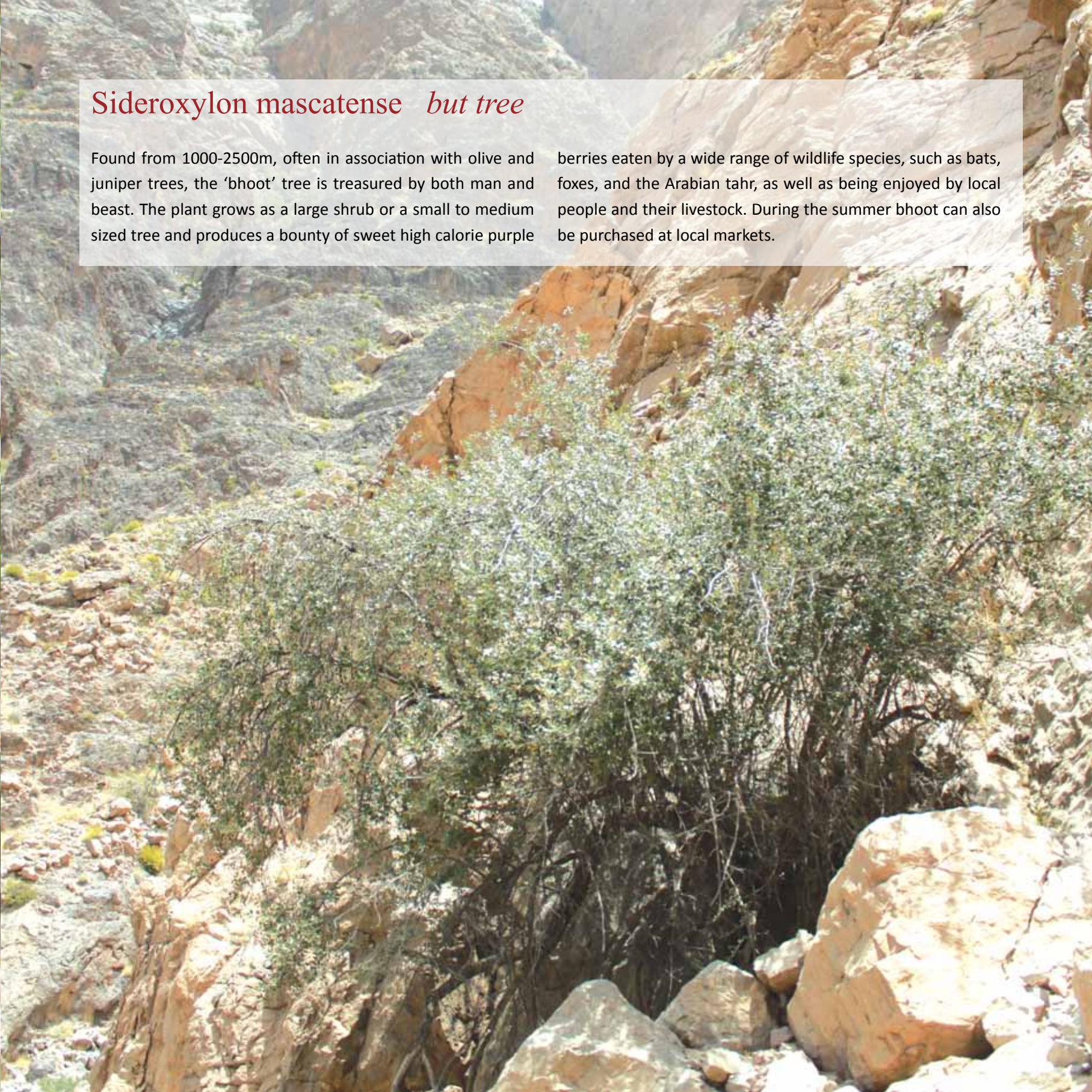
Sidr trees, found in Oman at altitudes of up to 1500m, are prized for their small reddish brown fruit, known as nabaq. These popular calorie-rich fruits can be eaten raw, dried or ground into a mealy powder which is eaten raw or cooked with milk. Medicinal uses of the tree's leaves and seeds include treatment for mouth ulcers, bruises, chest pains and as a shampoo. As well, the sidr's leaves are an important fodder item and the tree's dense wood is valued for carpentry, construction and as firewood. Long tap roots mean the tree is highly drought and heat resistant – this hardiness combined with its many uses make it a valuable tree throughout its range from northeast Africa to northwest India. The sidr tree is mentioned in the Qur'an in a description of paradise and is considered sacred by many cultures.

Umbrella thorn *Acacia tortilis* Samur

The nutritious twisted pods of Acacia tortilis are important food item for both domestic livestock and wildlife, including the Arabian tahr. Its spreading crown, from which it gets its common name, provides welcome shade. This drought resistant tree is native across much of Africa and the Middle East, and has been introduced in other arid areas.

Wild drumstick tree *Moringa peregrina* Shua

Oil extracted from the seeds of the wild drumstick tree, known as 'Shua ben oil' has been prized since biblical times for its use in cooking, cosmetics and medicine. The antioxidant and anti-inflammatory properties of the oil have also been confirmed in laboratory examinations. In some areas the seeds are used to purify water, and the cooked tubers can be eaten. In Oman the tree occurs on mountain slopes up to 1200m.



Sideroxylon mascatense *but tree*

Found from 1000-2500m, often in association with olive and juniper trees, the ‘bhoot’ tree is treasured by both man and beast. The plant grows as a large shrub or a small to medium sized tree and produces a bounty of sweet high calorie purple berries eaten by a wide range of wildlife species, such as bats, foxes, and the Arabian tahr, as well as being enjoyed by local people and their livestock. During the summer bhoot can also be purchased at local markets.

2.4 Fauna

The Arabian tahr is one of many members of an interacting wildlife community, from grasshoppers and bats to foxes and wolves, each contributing to the functioning of the ecosystem. Many species exhibit physiological adaptations to the arid conditions, others survive by accessing remote pockets of resources on precipitous slopes, while some are generalists by nature and are equally at home on cliff faces as in woodlands or plains.

For some of these species, the mountains are a vital habitat. The Hajars have been recognised as an important centre for reptiles and amphibians, home to three species of lizard found only in Oman and five found only in Arabia. The Jebel Akhdar/Jebel Shams area of the mountains has been designated an 'Important Bird Area' by Birdlife International, as it provides an essential refuge for a number of species.

Sadly, the mountains have not provided the same kind of safe haven for the larger predators. Reviled and hunted as a livestock killer, the Arabian leopard disappeared from the Hajar Mountains in the 1970's and its presence in Musandam remains uncertain. The Arabian wolf also suffers from a reputation for livestock predation, and continuing persecution may soon consign it to a similar fate. The striped hyena too is very rare; it is restricted to lower altitudes and its presence there is only sporadically confirmed.

Smaller carnivores and insectivores like Blanford's fox, Gordon's wildcat and Brandt's hedgehog have done better. Largely nocturnal animals, they are rarely seen, but their activities are more compatible with humans, though not unaffected by disturbances to their ecosystem. For the iconic mountain ungulates, the Arabian mountain gazelle and the Arabian tahr, the critical protection they receive in the Hajars is fundamental for their survival.

On the following pages is but a small selection of the faunal species that live alongside the Arabian tahr, each contributing in ways large and small to the maintenance of the ecosystem that is the tahr's home.

Gazelle pronking in response to danger

Mountain gazelle *Gazella gazella*

Though once widely distributed across the Arabian Peninsula, the largest population of this slender graceful gazelle is now in Oman. Worldwide they are considered vulnerable to extinction, threatened by hunting for meat and live capture for private collections. Mountain gazelle in the Hajar Mountains are often referred to as the Arabian mountain gazelle (G. gazella cora), but whether or not they are a distinctive subspecies is still under debate. A grazer by choice, Arabian mountain gazelles will also browse on shrubs when grasses are in short supply. They are well adapted to their arid environment, though they will drink when water is available they can obtain all the moisture they need from their diet alone. They live in small herds of three to eight animals. Like all gazelles they pronk when alarmed, bouncing impressively on stiff legs, and can run at speeds reaching 65 km/hour.

Blanford's fox *Vulpes cana*

Weighing only 0.9-1.5kg, this diminutive fox inhabits arid mountains from the Middle East to Afghanistan, and is distinguished by its oversized ears, long bushy tail, and a distinctive black band running from the tip of its sharply pointed muzzle to the inside of its eyes. Its jumping ability is probably its most impressive attribute; small feet with naked pads and sharp curved claws give it superb traction on the steep cliffs and rocky slopes it favours, allowing it to scale vertical cliffs with astounding three meter bounds. Blanford's foxes live in monogamous pairs, emerging at night to forage alone for insects and fruit. While thought to be widespread in Oman, Blanford's fox is nocturnal and therefore rarely seen, and was first officially recorded in Oman in 1985.

Red fox *Vulpes vulpes*

The hugely adaptable red fox is the most widely distributed carnivore in the world, able to live in a large variety of habitats from tundra to desert, even thriving in cities. Red foxes are opportunistic omnivores, eating a wide variety of foods including small mammals, birds, insects, fruit and carrion. With superb senses of hearing and smell, and long hind legs in comparison to other canids, they are remarkably good at locating and pouncing on prey. To communicate red foxes use scent marking, facial expressions and vocalisations, 28 of which have been recorded. They are able to run for several kilometres, at up to 48 km/hour. Given their dietary and habitat overlap, there are concerns that the red fox may compete with and displace the smaller Blanford's fox.

Gordon's wildcat *Felis silvestris gordoni*

Gordon's wildcat is similar in size and general appearance to the domestic cat, but can be identified by its unique coloration – russet-brown on the backs of the ears, three distinct black bands around the tip of the tail and black bands on the forelegs, and naked pads which are black rather than pink. Gordon's wildcat is restricted to the UAE and northern Oman, and like wildcats elsewhere is at risk from hybridisation with domestic cats.

The Arabian wolf photographed by Dr. Andrew Spalton. Many wolf traps like this now lie unused. The traps were baited with meat and when the wolf pulled on the meat a rope would release a stone door, trapping the wolf inside.

Arabian wolf *Canis lupis Arabs*

A sub-species of the much maligned grey wolf, the smaller desert adapted Arabian wolf also suffers from a reputation for livestock depredation. Through systematic shooting and trapping the Arabian wolf has been eradicated from most of its former range in the Middle East. Small populations endure in parts of the Arabian Peninsula, Syria, Jordon, and in Israel where they benefit from protection. Little is known about the size of the wolf population in Oman, but sightings are uncommon, and the many now abandoned wolf traps found in the mountains point to a declining population.

Egyptian vulture *Neophron percnopterus*

With its bold black and white plumage, kite shaped tail and naked yellow head, an Egyptian vulture soaring amongst the peaks of the Hajars is an unmistakable and unforgettable sight. A year round resident in northern Oman, Egyptian vultures nest on ledges or caves on cliffs and rocky outcrops, and feed on a varied diet including carrion, small vertebrates and insects. While populations appear to be stable in Oman, elsewhere this endangered raptor has suffered catastrophic declines, particularly in India, likely as a result of poisoning by the veterinary drug Diclofenec.

Lappet-faced vulture *Torgos tracheliotus*

The awesome Lappet-faced vulture can be easily identified in flight by its huge rectangular fringed wings, or when resting by its naked head and powerful hooked beak. Though primarily a scavenger, there is evidence that Lappet-faced vultures also hunt. They appear able to swallow quite astonishing amounts of food – an entire regurgitated small antelope leg was reportedly found in a nest in Kenya. While adept at foraging in open savannas, arid plains and deserts, the Lappet-faced vulture requires trees for roosting and nesting, and these are an essential component of their habitat. The huge flat nests are normally built on top of acacia trees, and are used year after year. Approximately 8000 Lappet-faced vultures are thought to exist in Africa, and only 500 in the Middle East. The Hajars are a migratory stop over for this species, and is home to a number of breeding pairs.

Muscat mouse tailed bat Rhinopoma muscatellum

Identified by its oversized ears and characteristic long mouselike tail, the Muscat mouse tailed bat is found in the many caves common in the Hajars, where it roosts alone or in colonies of thousands. As it emerges at dusk it can be seen rising and swooping in a characteristic flight pattern so that it resembles a small bird. Insectivorous bats such as these play an important ecological role in controlling insect populations.

Oman saw-scaled viper *Echis omanensis*

Only recognized as a separate species in 2004, the Oman saw-scaled viper is restricted to rocky mountains in northern Oman and the U.A.E., most often found in wadis and near water. There it lies motionless, waiting for prey such as a toads. It attacks with a lightning strike before releasing its victim to succumb to the effects of the venom injected through its hollow fangs. Saw-scaled vipers are supremely adapted to arid lands - rather than expend moisture in hissing, when alarmed they rub the opposing coils of their body together so that the scales produce a characteristic sawing sound.

Persian horned viper *Pseudocerastes persicus persicus*

The venomous Persian horned viper is a medium sized but thick bodied snake, usually 50 – 60cm in length. It is named for its distinctive scale covered 'horns' above each eye. Though in Oman they are most often greyish brown with alternating darker bars on their back they can be a variety of colours depending on the substrate on which they live. They occur throughout the northern mountains in Oman, as well as Iran, Pakistan and Afghanistan, where they prefer exposed mountain tops and plateaus. The Persian horned viper delivers its venom through two hollow fangs which, when not in use, fold flat against the roof of its mouth.

Sinai agama *Pseudotrapelus sinaitus*

This small agile agama found in arid mountains and foothills and is most conspicuous during the breeding season, when the male's head, or sometimes whole body, turns a bright sky blue. At this time he climbs on rocks and scouts the surroundings for females, with whom he communicates with head movements, nods and comic push-ups. The Sinai agama feeds on insects such as ants and grasshoppers.

Yellow spotted agama *Trapelus flavimaculatus*

The yellow spotted agama is uniquely adapted to the desert climate. In arid environments like the Hajars, every drop of moisture is precious. In a behaviour termed 'rain harvesting', the yellow spotted agama sets up its own catchment area to maximise water intake during rain - lowering its head while raising its back and tail and splaying its legs, it uses gravity and capillary action under its scales to carefully channel water to its mouth so it can drink.

Insects

Though insects rarely receive the same attention as the larger charismatic mammals, they are the most diverse and abundant group of animals that share our world. They are of enormous importance to the functioning of natural ecosystems and human lives, pollinating plants, decomposing plant and animal remains so that nutrients are returned to the soil, and providing a source of food for many creatures.

Dragonflies are predators of flying insects, often small flies, but also larger insects such as wasps or butterflies.

The vibrantly coloured striped mantis (Blepharopsis mendica) manages to look remarkably leaf-like as it perches on low bushes, waiting to ambush prey such as small insects.

Gangling grasshoppers (Truxalis procera) are found on the Hajar Mountains where their favoured grass food source is found.

CHAPTER 3
FIT FOR PURPOSE: THE BIOLOGY OF THE ARABIAN TAHR

Each species on earth is a constantly evolving solution to the universal challenge of survival - how to stay alive and reproduce within the confines of a dynamic ecosystem. Physical and behavioural adaptations allow animals to access and utilise essential resources like food, water and shelter whilst successfully competing against other species with similar needs. Predators must be evaded and species have evolved to fight, flee or hide from danger.

To find the Arabian tahr within the Hajar Mountain ecosystem we must climb, then inch along pencil thin ledges across a maze of broken cliffs. Tahr are most often found on north facing cliffs above 1000m. Here environmental conditions favour plant growth, yet this vertical world also poses enormous physical challenges. The tahr is specially adapted to this unique habitat, able to find advantage over others and thrive in a place few dare to venture. Though the Arabian tahr's low density and the inaccessible nature of the terrain have made it a difficult subject to study, we are now through perseverance beginning to uncover the secrets of this iconic species. The Arabian tahr is, like no other, a creation of the Omani mountains.

3.1 A changing coat for changing seasons

An animal's coat often performs a dual function of providing protection from the elements and camouflage from predators. Temperatures on winter nights in the mountains can drop below freezing, whilst under the intense sunlight of summer days it is roasting hot. The tahr's coat changes seasonally, reflecting environmental conditions. The reddish-grey of the adult tahr's thicker winter coat blends with the cliffs as it moves from rock to shadow. In April/May tahr moult, revealing a lighter sand coloured coat, so that in summer when intense sunlight bleaches the landscape the tahr is still difficult to see. Newborns are particularly vulnerable to predators like birds of prey, foxes and caracal, especially when their mothers go off to feed and drink. Their dark grey coats ensure that they remain hidden in the shadows where their mothers have left them to lie in wait.

As well as camouflage, the pattern and coloration of an animal's coat sometimes have a more subtle function. Research has shown that certain prominent markings on an otherwise uniform pelage are commonly used in communication. The tahr has several such markings including a black crest on its back, particularly prominent on males, and white markings on either side of the nose of females and young.

The female's coat is sleeker and lighter in summer (left) than in winter (right).

The male's dark crest can be erected and may be used for communicating during reproduction, conflict, or for other unknown reasons. When presented in profile the erected crest gives an impression of increased muscular development. Such a show of strength could be a warning to opponents or an attraction to a potential mate. Similarly, the greater amount of hair on males in comparison to females, on their backs, their legs, their beard and mane could also give the impression of greater size. As males have evolved to be larger than females, size in males obviously provides a reproductive advantage.

Recent work on other ungulates has suggested possible reasons for the white markings tahr have on their face. Such conspicuous markings on the face may allow other tahr, especially mothers with young, to locate each other more easily. Males lose these markings as they age but all young and all females are marked in this way.

The male's light summer coat (left) and thicker, darker winter coat (right).

Large mature males have darker more spectacular coats and darker faces than younger males. The long black hair on the male's back can be erected, making him look more imposing.

Striking white face markings on females, young and sub-adult males make it easier for group members to find each other. This is particularly important for females with dependent young.

3.2 Horns: tahr weaponry

Male and female tahr both have horns, but their different size and shape alludes to their differing functions. The male's horns are much stronger, longer, wider and thicker at the base, curving gracefully backwards and tapering to a point. The female's horns are shorter and thinner, almost ornamental in comparison.

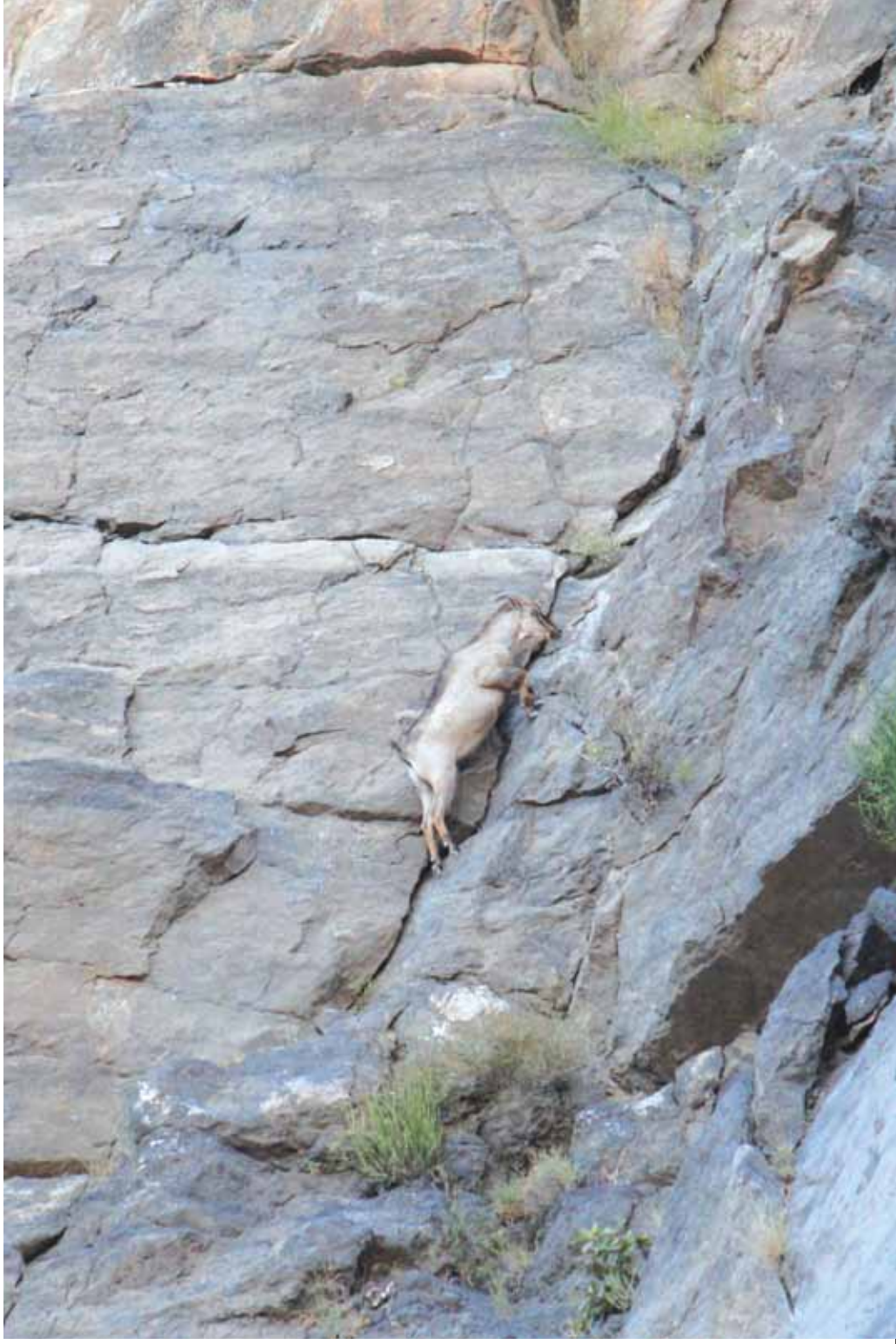
The size and shape of horns in wild goats and antelopes is generally related to different types of male fighting behaviour and social organisation, for if males have to compete for mating rights then horns must be able to do battle. For example, ridges on horns hold opponents together while they wrestle, short spikes are used to stab opponents, and long horns are best for wrestling and fencing. The robust horns of male tahr suggest that males may compete with each other to establish dominance and mating rights; the curved, ridged shape of their horns suggests that males fight by ramming and wrestling. Recent video evidence has confirmed this fighting style.

Males' horns (left) are more robust, longer and wider than those of females (right).

Tahr are most active at dawn and dusk, escaping the midday heat by resting in caves or the shade offered by overhangs and cracks on cliff faces.

3.3 Mountain hardware: hooves for heights

In this mountain landscape it is hard to imagine moving quickly. There are few toe holds on the vertical cliffs, narrow ledges are precarious pathways and a fall would be disastrous - even the flatter areas are littered with a jumble of large boulders and rocks. The tahr's split rubbery hooves give superb traction on rock and a hard rim around the hoof provides an edge to grip on the tiniest of cracks, allowing them to scale impossibly steep rock faces and bounce across boulder littered wadis at great speed. Importantly, this superior gymnastic ability helps them to outmanoeuvre predators. In fact, tahr are not found on mountain plateaus, despite what appears to be ample vegetation there; it is possible that the very steepness of the cliffs they prefer is a crucial component of optimal tahr habitat because it gives the tahr a physical advantage over its predators and competitors.



A large male tahr scales a cliff face that even a rock-climber would find difficult. The tahr's supreme balance, adaptable hooves and excellent climbing technique, make them the gymnasts of the animal world.

3.4 Diet

The tahr is a grazer-browser, selectively feeding on the leaves, fruits and seeds of a variety of trees, shrubs and grasses. Tahr are most often found on north facing cliffs at altitudes above one thousand meters. Here environmental conditions favour plant growth and higher species richness due to increased rainfall and shade from the sun. While the rocks at first appear barren a closer look reveals small green shrubs dotting the cliff faces and ledges adorned by wisps of grasses and herbs. Thirty-seven plant species have been identified as consumed by the tahr, though the actual number is likely to be higher. The most frequently eaten plants include Chrozophora oblongifolia, Cenchrus ciliaris (a nutritious grass) and Lavandula subnuda (a flowering herb). The tahr's diet changes according to seasonal availability, which is in turn largely dependent on rainfall. During rainy periods the tahr concentrates on eating ephemeral grasses, which are nutritious and rich in protein at that time. When the nutrient quality of grass decreases during dry periods the tahr switches to eating more trees, shrubs, and fruits.

Rhus aucheri Qataf is eaten by tahr and is an Omani endemic occurring commonly in the foothills of the Hajar Mountains. It is said that the leaves and bark of the shrub are locally used in the treatment of malaria.

Ochradenus arabicus is commonly eaten by tahr. The species has been reported from Saudi Arabia, Yemen, Oman and The United Arab Emirates, where it grows in limestone rocky ground and sandy arid places up to 2000m above sea level.

An Arabian tahr in a typical productive mountain habitat. Although the cliffs often look barren of life, a diverse assemblage of plants survive amongst the rocks, particularly on ledges.

Many species that are adapted to arid environments, such as the mountain gazelle, Arabian oryx and the aoudad (the tahr's closest relative) do not require drinking water. The tahr's requirements for water are still being investigated. In the cooler winter, tahr appear able to obtain much of the moisture they need from their diet, but as the temperature rises they visit water pools more often. We do not know if tahr are in fact dependent on these water sources or whether they simply prefer, but do not absolutely require, drinking water during hot weather. We do know that they will travel considerable distances down the mountain to drink from pools in the lower wadis during summer, suggesting that access to water is a great advantage.

The tahr's unmatched ability in the mountains gave it nearly exclusive access to the essential resources of food and water – until the introduction of the domestic goat. There is a large overlap between the diet of tahr and domestic goats; of the 37 plants consumed by the tahr, 30 were also eaten by goats. Unfortunately goats are of a similar build to tahr, and are nearly as nimble climbers. The proliferation of goats in the mountains puts pressure on the productivity of the fragile mountain ecosystem, directly threatening the tahr.

3.5 A social life

Tahr are most often found alone or in very small groups. The most common social unit is up to four animals, consisting of one male, one to two females and one young. While males are more likely to be found alone than females, new data suggest that groups of two to three males often form, though the largest and most likely dominant males are more often alone. Herd sizes in ungulates are a function of both social needs and environmental constraints, and the small groups in which tahr are found may reflect their available food resources. Plants are generally found in small dispersed pockets and small groups of tahr are better suited to using such small resource patches without depleting them than are larger herds.

3.6 Reproduction

Though the tahr's reproduction cycle is still being investigated, it appears that most mating activity (the rut) occurs during October to December. The gestation period is 140 to 145 days and most births occur between late March and early April. While there are reports that tahr can give birth at any time of the year, spring to early summer is likely the most favourable time for kid survival. Reproduction in captivity has shown us that in good years it is possible for tahr to give birth twice in one year. However only single kids are born, and unlike other ungulates, tahr never have twins.

3.7 Tahr ‘medhas’ and their role in social communication

One of the most conspicuous signs of tahr in the mountains is the ‘tahr pit’, locally known as a medha. Tahr dig these distinctive pits by vigorously scraping at the ground with their hooves and horns to create a sandy depression up to 2m long, 1m wide and 50cm deep. They are usually dug in sandy or gravel soils in flat areas or on promontories on the edge of cliffs. Pits may be used repeatedly and last for years, or be abandoned after a season. Previously the uses of these pits could only be inferred, but video camera traps (cameras switched on by the body heat of passing animals) have now allowed researchers to document the fascinating behaviour of tahr at these pits.

A tahr pit, known as a medha. Only tahr make these distinctive marks in the mountains.

Tahr typically uses these pits in the following way. A male approaches the pit and begins by rubbing the length of his neck up and down against the pit's edge. Next he moves into the pit and tosses up clouds of sand as he gouges the ground with his horns, sometimes covering himself with dust, and repeatedly rubbing his head on the pit and all over his body. All the time the tahr wags his short black tail at a rate of 3-4 times per second. Occasionally males will contort their bodies so that they can urinate on their heads, and then vigorously rub the urine into the pit. The entire rubbing sequence can last anything from 30 seconds up to 7 minutes. Females also wallow and dust in pits, though much less often and less vigorously than males. In addition, females have been observed rubbing their heads on rocks and earth, making smaller marks than those made by males.

An example of the behaviour of male Arabian tahr at pits, captured by camera traps. Dusting in pits is an enthusiastic display of rubbing, tail wagging and throwing dust.

Tahr at pits then dust themselves by throwing soil in the air and on their bodies.

Dusting like this is an effective method for removing parasites that is used by many species. Yet the range and intensity of rubbing behaviours witnessed, and particularly the use of urine, strongly suggests that the pits may also serve a second function – communication using scent.

Communication is fundamental to all societies, be they human or animal. Many animals, including ungulates, use odours and scent marking to communicate. The main sources of scents in animals are urine, faeces, saliva, reproductive secretions, and specialised scent glands, which are often found (in ungulates) below the eyes, between hooves, on the rump or on the forehead. Scents are deposited by rubbing secretions on sand, trees, rocks or other objects, and to the sensitive nose can reveal information about sex, identity, reproductive status, and health. Urine, in particular, contains metabolic by-products that indicate physiological condition which can be related to muscle mass and fitness. Such information can allow females to identify and assess the condition of potential mates, alerting them to the presence of prime specimens. As well, scent marking allows males to communicate with competitors and gauge each other's strength, a form of diplomacy establishing hierarchy and allowing them to avoid dangerous face to face conflicts that could result in injury.

Previously it was thought that pits were used by individual male tahr to mark their territorial rights to an area, but camera-traps have revealed that pits are frequented by many different individuals. Up to eight different males have been observed using the same pit at different times, and sometimes a number of males visit and use the pit together. This suggests that pits serve to advertise the presence, and possibly status, of individuals rather than acting as a signpost telling other individuals to keep away, as is the case with territorial markers.

Males sometimes spray their head or the pit itself with urine, then vigorously rub their heads in the pit and on their backs. Such behaviour strongly implies that tahr use pits to communicate with each other though scent marking.

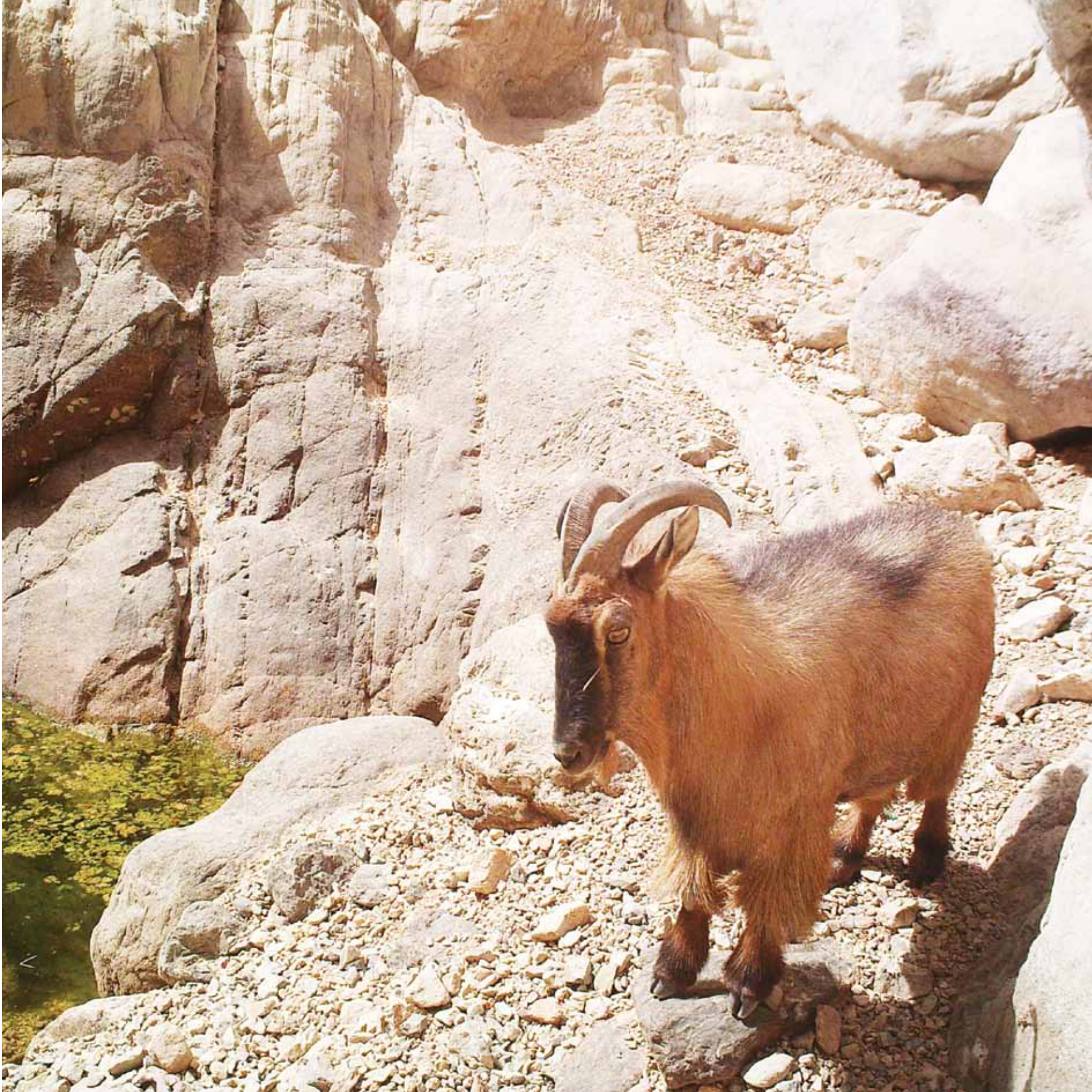
Males sometimes use pits in small social groups, such as these three males.

So if pits are not simply used to remove parasites and nor are they simple territorial markers, what are they being used for? Research is ongoing, but a number of explanations can be suggested. Firstly, pits may function on a visual level, signalling presence or acting as a visual marker. Secondly, the rubbing and wallowing behaviours observed indicate that tahr are dispensing scents and providing signals to other visiting tahr. Urine rubbed in the pit contains metabolic products, and may serve to advertise the male's physiological condition and possibly rank to potential rivals reducing the time, energy and dangers associated with actual physical confrontations.

Interestingly, tahr appear to use pits more frequently closer to the breeding season and cease for a few months after breeding, indicating that these behaviours may have a role in reproduction. Females visiting the pits may be able to gain information about males and decide which males are the most attractive. On the other hand males may obtain information from smaller rubs created by females on which females are ready to mate.

The Arabian tahr belongs to the towering rocks and spires of the Hajar Mountains, adapted over many thousands of years to this vertical world. We are discovering how the tahr copes with its challenging habitat through its superb gymnastic ability, a social system geared towards using small dispersed resources and a reproductive strategy that overcomes the sparse resources and an extreme climate. As further study deepens our appreciation of this unique creature, we are also becoming better able to conserve the tahr. For now is the time to move from awe to action, to understand the tahr's needs and ensure they are met.

Females also visit pits, but less often than males and their use of the pits is also much less vigorous. Females more commonly create small marks on the ground, which may serve the same function.



CHAPTER 4
CONSERVATION: THE FUTURE OF ARABIAN TAHR

Seeing an Arabian tahr in the wild is an experience you never forget. It is difficult to describe just how at home it is in its mountain habitat, the assurance with which it negotiates the precipitous cliffs, how effortlessly it moves across ledges to delicately browse the sparse shrubs, leaving so little trace of its presence. Watching the tahr inside this fortress of cliffs it is easy to forget the outside world, easy to be lulled by the tranquillity and imagine that this pocket of nature will always endure. But in this age, such thinking would be dangerously naïve.

The world is in the midst of an environmental crisis as our growing human population, increased development and energy hungry lifestyles put unprecedented pressure on ecosystems and natural resources. Across the earth plant and animal species – key parts supporting human life – are in decline. Even the Arabian tahr, which stands so confidently on these precarious cliffs, is in fact teetering dangerously close to extinction. Oman has long played an important role in conservation in Arabia. That the tahr survives at all is a sign of hope, a testament to the people and leadership of Oman. But we cannot afford complacency, for only through action today can we secure the future of the Arabian tahr.

4.1 A species on the edge

Over hundreds of millions of years of earth's history many aspects of its climate and habitat have changed, and in response to changes species have gone extinct and new ones emerged. Extinction is therefore a natural process. But the rapid loss of species we are seeing today is between 1000 and 10,000 times higher than the expected natural extinction rate. Unlike past extinctions, humans are known to be responsible for the current extinction crisis, which has widespread implications for both human and environmental security.

The Arabian tahr is classified as Endangered, one of the highest threat categories, defined as having a very high risk of becoming extinct in the wild. The assessment is based on the Arabian tahr having a small and fragmented population that is in decline. Habitat loss and fragmentation, competition with livestock, hunting and live trade continue to be the main threats to the Arabian tahr, while biological factors including a limited geographic range, specialised habitat requirements and a small population contribute to their vulnerability.

4.2 Habitat loss and fragmentation

New economic opportunities in Oman since the discovery of oil have brought many changes to the Hajar Mountains, delivering wealth and services to previously isolated communities. The main causes of habitat changes in the Hajars are an expanding road network, urbanisation and mining. Such development is important but also impacts tahr and other wildlife in a number of ways that must be understood and mitigated where possible. Habitat loss reduces the space Arabian tahr have to use. Development may also fragment tahr habitat, resulting in barriers between populations that restrict movement, reduce gene flow and result in smaller less resilient populations.

New roads bring important benefits to people living in remote areas, but the impacts on wildlife and habitats need to be better understood.

Wildlife bridges have the potential to reduce the fragmenting impacts of roads on wildlife. Pictured is 'The borkeld' a wildlife bridge in the Netherlands designed by Zwarts & Jansma Architects. Photograph by Irvin van Hemert.

4.3 Competition with domestic livestock

The substantial overlap in the diet of tahr and domestic goats leads to competition for food resources. The extent of diet overlap could mean that each goat using tahr habitat may effectively take the place of an Arabian tahr by lowering the capacity of the habitat to provide necessary resources. Overall, livestock numbers appear to be decreasing as mountain dwellers begin to rely on other sources of income, lessening pressure on mountain pastures. At the same time, as more people move to the cities in search of jobs and education many herds are left without active shepherds. Unattended goats may stray, turn feral and move into remote tahr habitats. The expanding road network also facilitates the transportation of livestock and supplementary food and water into new areas, increasing the potential for competition with tahr. As well as reducing mountain resources, the mixing of goats with tahr increases the likelihood of tahr contracting diseases that could cause life threatening illness.

A large degree of dietary overlap between tahr and goats leads to competition between the two species for available resources. Small goat numbers are unlikely to be a problem but larger herds put pressure on mountain pastures.

4.4 Hunting and tahr trade

Historically tahr meat was a welcome addition to the sparse diet of mountain dwellers; nowadays a demand for animals destined for zoos and private collections is also driving live capture. Legislation prohibiting hunting, and active patrolling by rangers inside reserve areas has done much to deter poachers but unfortunately tahr outside patrolled areas remain at risk. Young tahr particularly are said to be preferred for live trade.

4.5 Biological causes of vulnerability

All animal species are not equal; some are more prone to extinction than others due to their biology. Scientists have found that the most vulnerable species are those with small geographic ranges, low density, large body size, low birth rate and specialised resource requirements. That the tahr has several of these traits heightens its vulnerability to extinction.

Species inhabiting small geographical areas have a higher chance extinction than other species. The area covered by Arabian tahr is small as they are confined to the Hajar Mountains, and limited to steep rocky, north-facing slopes with available water within this range. This leaves tahr more vulnerable to habitat destruction, threats, chance environmental disasters and climate change occurring within their range than if they occupied a larger geographical area. As there is effectively only one population, if their habitat is destroyed or altered, they have nowhere else to go.

The Arabian tahr's total population size is small, estimated at less than 5000 individuals (with less than 2500 mature individuals), though this figure is by no means exact. Small populations are more vulnerable to extinction because they are less able to recover from periods of increased mortality due to both natural environmental fluctuations, such as cyclones or disease, and to human caused threats, because they have a smaller breeding population on which to draw. As tahr live in small fragmented populations they may have lower genetic variability, possibly reducing the ability of the tahr population to adapt to new challenges such as disease. Tahr also live at low density and this can result in fewer encounters between individuals, which may reduce mating opportunities.

With a restricted geographic range and a small, low density population the Arabian tahr could all too easily be pushed over the edge by threats such as habitat loss, competition with livestock, hunting and live trade.

A female tahr in the Jebel Qahwan / Sebtah area. With a small population, small geographic range, and specialised habitat requirements the Arabian tahr is vulnerable to extinction.

4.6 Conservation initiatives

Oman has long played a unique role in the conservation of wildlife in Arabia. The natural inaccessibility of the mountains, the persistence of traditional practices and progressive conservation minded governance by His Majesty, Sultan Quaboos bin Said, has resulted in a refuge for many wildlife and habitats which are now on the brink of extinction elsewhere in Arabia.

Conservation efforts targeting the Arabian tahr began in the 1970's, when concerns over a declining population were first expressed. In 1975 the discovery that tahr were surviving in the Wadi Sareen area, only 40km southeast of Muscat, led to the establishment of a 200 km2 experimental reserve run by the Diwan of Royal Court, Office for the Adviser for the Conservation of the Environment. Local Bedu herders, some of them former tahr hunters, were employed as wardens to patrol the reserve. In 1976 the first study of Arabian tahr was conducted in the Jebel Aswad area to provide information on the basic biology of the tahr and make management recommendations.

The protection of the Arabian tahr has also allowed other forms of biodiversity to flourish.

A second important step forward in tahr conservation was taken in 1976, when a Royal Decree made it illegal to kill or capture Arabian tahr. These two steps aided the recovery of the Arabian tahr in the reserve area and the protected population in Wadi Sareen Reserve flourished. Over the years the ranger force and their area of jurisdiction has been expanded, though they continue to concentrate efforts in Wadi Sareen. In 1993 the Ministry of Regional Municipalities and Environment (now Ministry of Environment and Climate Affairs) established a small wildlife ranger unit in the Ja'alan, Jebel Qahwan / Jebel Sebtah area to guard a population of Arabian gazelle. In the following year their remit was expanded to look after a substantial and important tahr population in the same area.

In order to provide support for the wild population, in 1980 a captive herd of Arabian tahr was established at the Omani National Breeding Centre. This was to allow the possibility of reintroduction should populations become locally extinct.

For many years there have also been local land management systems that promote the conservation of nature. One of these systems is the 'hamiyat' or 'hema', a traditional pasture management system that has been important for the persistence of tahr in Oman. Under this system, tracts of land were set aside for specified restricted purposes such as cutting of fodder during lean times or hunting, resulting in areas that are botanically richer than grazed areas. The use of 'hema' can be traced back to the Koran and was once prevalent across Arabia. The reinstatement of these areas has been recommended as a means of safeguarding areas of pasture for tahr.

A ranger taking in the surroundings with the important Jebel Aswad area of Wadi As Sareen Reserve in the background.

A team of rangers protect the tahr in Ja'alan Bani Bou Hassn at Jebel Qahwan area, which forms the southern limit of the Arabian tahr population.

While tahr numbers appear to be benefitting from protection in some areas, in other areas the population has declined and in many regions we are unsure of the situation. The future of the Arabian tahr depends on the continuation of protection inside and outside reserves, a greater understanding of the Arabian tahr's biology and the awareness and support of the people of Oman.

4.7 Wildlife rangers and protected areas

That there are viable populations of the Arabian tahr left in the wild today is largely due to the commitment and dedication of Omani rangers, who carry out their patrols in arduous and often dangerous circumstances, climbing cliffs with expertise and at risk to their own lives. Law enforcement is the core duty of all rangers. Rangers conduct patrols to deter poachers and people using natural resources illegally. They are responsible for enforcing the law for serious violations as well as dealing with more minor infringements by educating people who have failed to understand why their practices may be damaging to the environment. Avoiding conflict and ensuring that respectful relationships are maintained with communities is a priority.

A typical day of patrol entails long hot hikes and steep climbs up near vertical cliffs. Rangers are highly skilled, extremely fit and are a rich source of local knowledge.

Rangers also play an important role in research. They are experts in the natural environment, a storehouse of traditional knowledge and importantly know access routes to remote areas of the mountains. These skills are used to assist and guide scientists, and the work supported by ranger teams continues to be an important part of tahr research. Rangers also directly contribute to research by recording information on all tahr sighted during patrols. The capacity of rangers is now being expanded to encompass more sophisticated techniques suitable for modern wildlife management and rangers are being given training in conservation biology, navigation systems, research and management methods. But regardless of new duties, the goal of rangers remains to protect and care for natural resources for the benefit of future generations.

Rangers taking a break for coffee and dates in the mountains during a patrol.

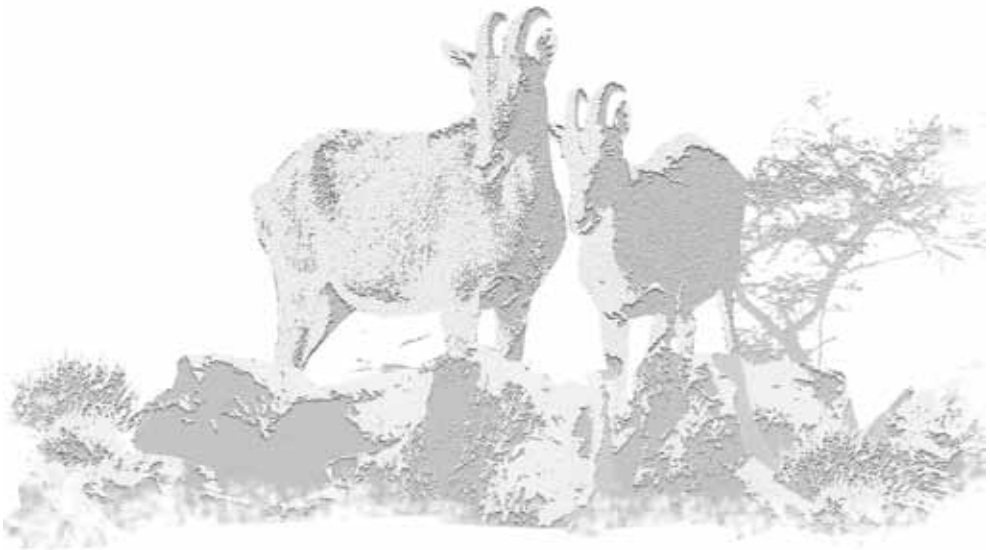
Training is an important part of equipping rangers for the challenge of species conservation and management.

4.8 Conservation research

Sound scientific knowledge is one of the foundations of effective conservation. Scientific research enables us to properly understand the habits and needs of a species so that we can address the most pressing conservation issues. This is achieved by answering important questions such as – where are tahr still present, what are their requirements for survival and how can we monitor the level of threat to the tahr population.

Camera traps are devices with a sensor that activates a camera to take a photograph or video when an animal passes by, recording date and time at the same instance. The resulting image or video then becomes a piece of scientific information, allowing scientists to prove the animal is present, often allowing animal density to be calculated, activity patterns to be determined and permitting behaviours to be observed through film that could not be seen otherwise. Camera traps thus have potential to provide scientists with a wealth of information remotely for over six months at a time with no requirement for humans to be present other than for set-up and collection.

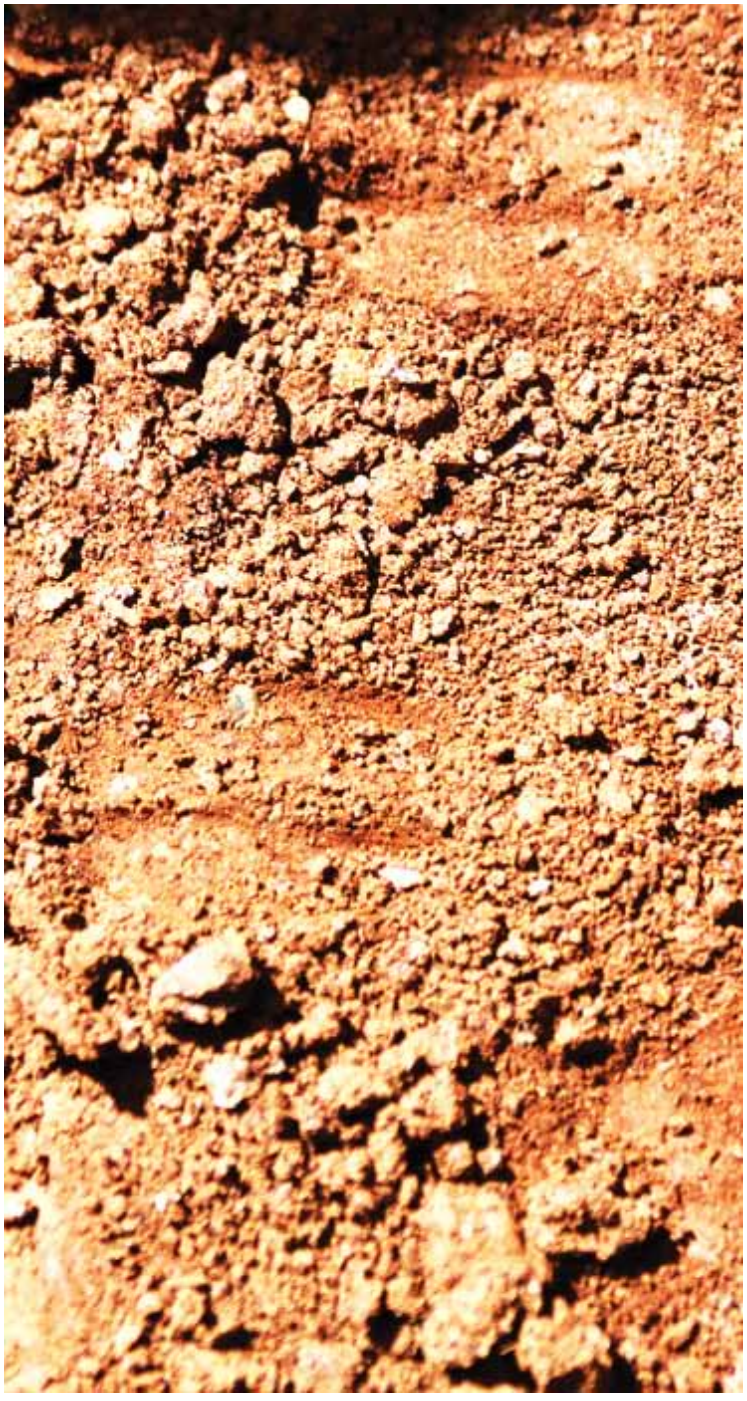
Currently we are using camera traps as a population monitoring tool and to understand tahr behaviour. We are monitoring tahr use of water sources, using the data to estimate population density and demographics, and monitor 'medhas' (pits) to gain insight into the tahr social system. Domestic livestock are also photographed at water sources, enabling us to characterise the nature of competition at these resources. The cameras are also giving us information about seasonal activity patterns and revealing a host of new behaviours. Beyond the science, cameras provide charismatic photographs and information of Omani wildlife that captivate people's imaginations. Communicating the wonder that surrounds us is a fantastic tool for education and enhancing people's interest in conserving Oman's wildlife.



Setting a camera trap to monitor wildlife movement and behaviour for months at a time.

If camera trapping is the easy way to obtain information and data, sign surveys are the hard way. Sign surveys are being used to understand where Arabian tahr are located across Oman and which parts of the mountains they are using. Tahr leave several conspicuous signs in the mountains including droppings, traces of hair, tracks and pits (medhas) that they dig with their hooves and horns. On each survey trained observers record the position of any signs and tahr encountered with global positioning systems (GPS). After many gruelling trips into different areas, terrains and habitat types scientists can use the data to understand tahr habitat preferences, which areas tahr appear to avoid and the reason why they are present in particular habitats. These investigations of habitat requirements can be useful to identify areas of prime habitat that are good candidates for protection, and can potentially be used to identify and preserve connections between tahr populations that are being separated by new developments.

A ranger discovers a tahr hair during a survey.



Various of tahr's signs include footprints, droppings and medhas.

4.9 Public involvement and education

Though failure to understand the biological facts behind conservation issues can lead to misguided management, biological knowledge alone is rarely enough for effective conservation. It is people who, often unwittingly, cause conservation problems, and people are the key players in solutions. For sustainable conservation we must understand both the needs of wildlife and of the local peoples, to formulate policies and initiatives that benefit both. Fortunately, there is often much common ground between the two groups. For example, the healthy ecosystems that wildlife requires also bring many benefits and services to local communities, such as wild fruit, medicines and clean water. Protected areas generate employment opportunities in the ranger service and the growing tourism industry, and when we protect the wilderness the rich natural and cultural heritage of Oman is also being preserved. The conservation of tahr has involved consultation with local people, by social scientists or facilitators, to understand their needs and aspirations. Adequate local involvement is important as it allows local people to take part in and understand the conservation process, making them more likely to support and assist conservation efforts.

Environmental education also has a critical role to play in tahr conservation. For a long time it has been known that substantial gains can be made in conservation by investing more in communication, education, and public awareness campaigns. Education of children is particularly important because it is an opportunity to intervene at a key developmental stage of life, and because children can be an important influence on the environmental behaviour of their parents.

4.10 Securing the future

With new research and resolve we are uncovering many of the secrets of the Arabian tahr, yet in some way whatever part of this creature we manage to capture in facts or photographs will necessarily fall short of the real thing. The true essence of the Arabian tahr can only be found in the wild, where it roams free in the majestic mountains it calls home. If we allow the Arabian tahr to disappear, to fall the way so many other species have done, we will lose much more than simply this singular wondrous creature. The Arabian tahr is an elemental part of the same mountain ecosystem that we are, and it will be our own home that is impoverished by its absence.

Let us hope that the Arabian tahr will turn a corner, that our awareness of its plight and commitment to its future can pull it away from the edge of extinction. Now is the time to intensify our efforts, to work together using our diverse knowledge and collective vision to secure its future, so that the Arabian tahr remains a proud symbol of the Omani wilderness for many generations to come.

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