

The Flora of the Sultanate of Oman



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From a Vanishing Past to New Opportunities — Transformation Processes in Omani Mountain Oases

Old farmer harvesting a unique wheat landrace at Balad Seet, Wadi Bani Awf.



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For millennia highly developed oasis farming and fishing has determined the livelihoods of the sedentary people of Oman. Famed as the land where frankincense originated (from *Boswellia sacra*), a major copper producer in ancient times and the residence of the legendary trader Sinbad the Sailor, Oman was barely accessible to foreigners prior to 1970. As an enlightened Islamic Sultanate, the country has since experienced an uninterrupted process of cultural and economic transformation; from a country of nomads who bred the fastest camels in the world, the oasis farmers, fishermen and seafarers, who were already trading with India

on a regular basis using their sturdy boats made of reeds and later wood, in around 3000 BC, it has become a society based predominantly on the oil industry and services. Today the traditional oasis economy as the material basis and key formative element of Omani culture has taken a back seat, becoming an exotic peculiarity and a tourist attraction. As a consequence many of the oases that have become easily accessible through newly constructed tarmac roads have turned into 'housing estates under trees', while remote settlements have become weekend residences or have been completely abandoned.

Recent interdisciplinary work has unravelled the way in which remote mountain oases function and highlighted opportunities for their development (Luedeling et al., 2005; Wichern et al., 2004). Examples presented here are the mountain oases of Maqta in Jebel Bani Jaber (a small 'scattered oasis' settlement 1,050 metres above sea level), Al 'Ayn and Ash Sharayjah (two small core oases at an elevation of 2,000 metres), in the massif of Al Jebel Al Akhdar, the small oasis of Al Sawjarah,

hundred goats and sheep are taken to graze in the mountainous desert surrounding the oasis, and in the evenings their diet is supplemented with high-protein fish, high-energy dates, kitchen leftovers, wheat bran and alfalfa. Local farmers have built up the elaborate terraces over millennia carrying tens of thousands of tons of wadi sediment into the oases. These man-made soils are used intensively for farming which is characterised by large surpluses of added nutrients from manure and



Left: Decay and transformation of oasis settlements on Al Jabal al Akhdar: abandoned village of Wadi Habib.

Right: Aerial view of the 'Hanging Gardens' of Al 'Ayn on Al Jebel Al Akhdar

which has only recently been connected to the road network and public infrastructure, as well as Balad Seet (a large core oasis at 1,000 metres) in the northern Al Hajar mountain range.

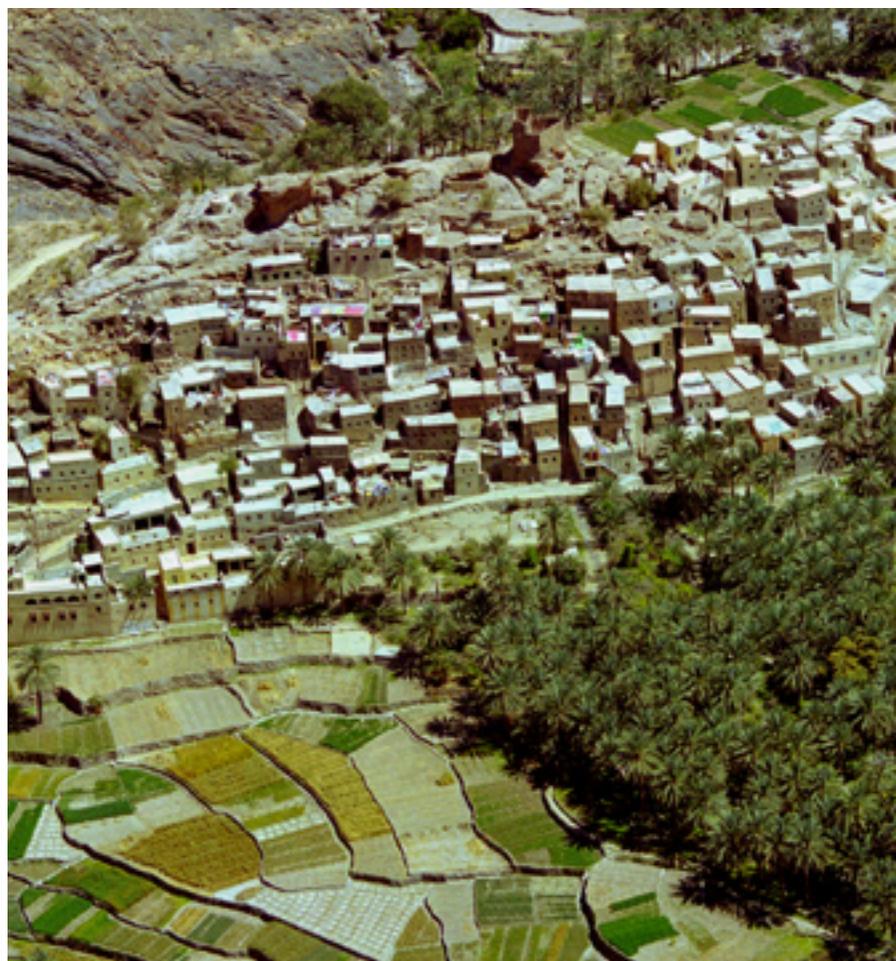
All these sites are characterised by their use of the highly efficient *Aini Aflaj* water supply system (Wilkinson, 1977; Norman et al., 1998; Golombek et al., 2007; Siebert et al., 2007), a spring-fed canal system probably developed on the Oman Peninsula in regions with an annual precipitation of 100-200 mm, whose origins are believed to date back to between 1000 and 500 BC, as well as by intensive interaction between terrace crop farming and animal husbandry. Observations, periodic GPS collar tracking and feed intake studies showed that once or twice a day, herds of often a few

mineral fertilisers (Buerkert et al., 2005). Studies of the morphology and molecular genetics have revealed that local varieties of wheat (*Triticum* spp.), which are grown as landraces on these terraces but are currently disappearing rapidly, are unique worldwide (Al Maskri et al., 2003; Al Khanjari et al., 2007a,b). Five newly discovered varieties of bread wheat and four of durum wheat, as well as on-going work on banana (*Musa* spp.), emphasise the ancient function of Omani mountain oases as important sanctuaries for genetic resources (Gebauer et al., 2007). Comparative fingerprinting studies with wheat accessions from the world's germplasm collection provided evidence for the ancient trade relations Oman maintained with all major countries in the region (Zhang et al., 2006).

Maqta territory is situated at the foot of the Shir plateau with its monumental 4,500-year-old limestone-built towers, discovered in 1992, and extends over an area covering approximately 25 square kilometres (Siebert et al., 2005). Because the Shir towers have been completely plundered and used as shelters for shepherds over millennia, precise dating and interpretation is difficult, but comparison with similar structures in the region provides strong evidence that they were originally tombs. Their concentration and orientation suggests that they may also have been used as 'signposts' to point the way to the most important

were periodically used by nomadic herds of sheep and goats. Today, the central settlement with 59 stone buildings, which are predominantly used for storage, retains its importance for Maqta's approximately 200 semi-nomadic inhabitants with their flocks of sheep and goats, and their 16 terrace systems fed by 22 tiny springs, which cover a total area of only 4.5 hectares. Due to below-average precipitation during the study period (2000-2003), many areas had been abandoned and one of the newly discovered ancient varieties of wheat had become extinct. As a result of its isolation and its precarious water

Left: Ancient aini aflaj system at Balad Seet, Wadi Bani Awf.



springs. A 20-metre deep sedimentation profile, reaching all the way back to the Pleistocene era (around 20,000 years ago; Fuchs et al., 2007) was used as a palaeo-climate record after successful radiocarbon dating of mollusc shells, luminescence analyses of quartz minerals and the evaluation of pollen diagrams. The data provided little evidence that in contrast to earlier periods, when shifts of the Indian Summer Monsoon were reflected in alterations of the moisture regime, major climatic changes had occurred since the Shir towers were built. They also showed that irrigated farming in Maqta only started about 600 years ago, and prior to this, springs and pastures

supply, this oasis settlement is in acute danger of being abandoned completely, in spite of state infrastructure aid and transfer payments.

Right: The core oasis of Balad Seet in the upper part of Wadi Bani Awf.

The terraces on the Jebel Al Akhdar massif are famous far beyond the borders of Oman as 'Hanging Gardens' due to their spectacular location on the steep mountain slopes. GIS-based analyses of high-resolution aerial photographs made with a remotely controlled electric airplane and ground measurements on the thousands of plots, some of which are as small as a single square metre, allowed a representative assessment of matter flows at village level. The farmers who live in the settlements

of Al 'Ayn and Ash Sharayjah at an elevation of 1,980 metres, cultivate a total area of 2.4 hectares as rose gardens (used to distill rosewater of a very particular quality) and 10 hectares of terraces for pomegranates, walnut trees, limes, alfalfa, barley and onions, both for their own subsistence and for sale. They also keep a large number of animals, mostly goats and sheep, which are herded on the rough rangelands surrounding the settlements. According to the local inhabitants, a third of the

switch to (certified) organic farming would appear possible without much difficulty, from a cultivation point of view, due to the very sparing use of mineral fertilisers and the almost total absence of pesticides, and this would open up new marketing opportunities rewarding farmers for their hard work in the gardens. Levying entry fees to villages or for guided tours of the gardens by locals familiar with the area could also enable villagers to earn additional income from tourism.



original area of the terraces has been gradually abandoned over the past decade, as a result of the increasing shortage of water. The farmers put this down to the steady drop in precipitation that has taken place over the past few decades, but early photographs of the area indicate that the perceived water shortage may equally be due to the rapid construction of new settlements on the high plain of the Sayq plateau and the accompanying intensive watering of domestic gardens, coupled with an extension of tree cultivation on some of the terraces. The growth of tourism will further exacerbate the water shortage, though the oasis dwellers themselves also use more water today than they did just 30 years ago as a result of the introduction of modern amenities, including toilets, showers and electric washing machines. A

Al Sawjarah is also located on the Jebel Al Akhdar massif and comprises six stone houses and a few goat stables snuggled up under a rocky ledge on the mountain slope, overlooking a narrow, dry valley where walnut, pomegranate and peach trees grow. Due to the very low yield of the only spring in the village — just 0.7 cubic metres an hour — the farmers gave up cultivating plants requiring intensive irrigation, such as wheat or fodder, some years ago. The village, which today has a population of 50, only became accessible by motor vehicles in 2004, when a gravel road from the main asphalt road was built. The last part of the journey to the village through the dry valley still has to be completed on foot, with a climb up large stone steps. Once their last inhabitants leave, the ancient buildings are likely to fall into

*Omani mountain oases
are treasuring worldwide
unique germplasm of
wheat and banana
(Maqta in Wadi Khabbah
of the Jabal Bani Jaber).*

ruin rapidly, as so many have done already, unless they are preserved as a cultural and historical treasure in the form of a museum village.

The oasis settlement of Balad Seet, located on the western slopes of the Jebel Al Akhdar massif, currently has a population of 600 with large groves of date palms. Archaeological finds confirm that the settlement has been in constant use since the early Iron Age (around 1100 BC, Nagieb et al., 2004).

and mobile telecommunications network, make this village increasingly attractive for Omani weekend dwellers and individual tourists. An indiscriminate expansion of tourism in Balad Seet is likely to be accompanied by the same problems that have been observed elsewhere. This underlines the importance of collected data on the bio-physical functioning of Omani oases and their settlement history for national planning and political decision-making.



Left: Scarcity of water, labour and farming income are main causes for the decay of Omani mountain oases.

Right: Shir-Plateau with 4,500-year-old tower tomb.

Due to the large watershed, the dozen springs close to the oasis settlement still yield sufficient water, even after several years of drought, to allow dates and fodder to be grown, as has been revealed by regular measurements of water flow. Studies of the age of the water, using tritium and sulfurhexafluoride as tracers, suggest that the rain water seeps through the limestone and dolomite massif for five to six years before finally emerging at the oasis. This comparatively reliable water supply makes Balad Seet stand out from many other oases, in particular in comparison to Maqta, both in terms of the settlement history as well as its future prospects for development. The constant construction of new houses, the modernisation of old buildings and the installation of sanitary facilities, as well as the connection of Balad Seet to the road

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Left: Pollen profile dug to 20 m depth.

Right: donkey carrying liquid nitrogen for sample conservation at Maqta.