Salt Lovers

Suaeda moschata, Barr Al Hikman.

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To survive in saline environments, be it sea water, salt-water marsh or salt desert, the plants that live there have evolved strategies and mechanisms in their cellular features and growth patterns to fully adapt themselves to grow, flower and seed in such habitats. These plants are called 'halophytes' (from Greek *hals* (*halos*) 'salt' and –*phytos*, 'plant'). These are highly specialised plants that can live in hostile locations where most plants and animals would not be able to exist.

The land of Oman was not always a desert and the soils not always saline, however, over a period of several thousand years, unique geologic and climatic history, lowering of sea levels and the alternation of arid and wet climatic periods of the Arabian Peninsula have given rise to the present landscape and soils. In the present arid phase, large areas now lack surface water and have become salty due to excessive evaporation. The coastal and inland salt areas (*sabkha*) of Oman are amongst the largest occurring on the Arabian Peninsula, with the inland *sabkha* of Umm As Samim and the coastal *sabkha* of Barr Al Hikman being major landscape features. *Sabkhas* are also present east of Sayh Al Hayma in the At Tabaqah and Subhat Al Wad areas, and to the east and west of Wadi Mukhayznah on the Jiddat Al Harasis.

The largest inland *sabkha* on the Arabian Peninsula is Umm As Samim, which is about 100 kilometres long (north to south) and about 50 kilometres wide. It lies on the western border of central Oman, bordering the sand dunes of the Rub' Al Khali to the south and west. Evidence from the sequence of deposits in this *sabkha* show it was originally an inland lake which, over the last wet and dry periods spanning 30,000 years, has eventually developed into its current state in present times. The soil is highly saline, consisting of a main zone of salt crust, with brine close to the surface. Fresh salt is continually precipitated as a result of evaporation and the expansion breaks the surface into polygonal plates that buckle and heave and are bounded by rims of fresh salt. The crust accumulates wind-blown dust and gradually darkens. No life exists in this hyper-saline soil; however, halophytes are present at its edges.

The coastal *sabkha* of Barr Al Hikman occupies more or less the entire area of the Barr Al Hikman peninsula in eastern Oman. Areas above the high tide level are subjected to flooding by extremely high tides, storms and subsurface seepages from the sea. There are extensive mud flats on the eastern coast that flood at high tide, and tidal lagoons in the northeast and southwest. These are sea inlets that are separated from the sea for most of their length by sand bars, and low sandy dunes are present along the beaches. Inland, there are vast expanses of highly saline areas, encrusted with salt and devoid of vegetation. Historically, the Barr Al Hikman peninsula has been formed as a result of a fall in sea levels, and it shows an abundance of plant life, albeit restricted to the less saline areas.

Left: Halopyrum macronatum.
Right: Arthrocnemum macrostachyum.

Species living in *sabkhas* often occur in single or two-specie groups that have specially adapted to live in such conditions. As a result of the diminishing effects of soil salinity from the centre towards the edge of *sabkha*, the vegetation typically exhibits a zonation pattern of distinct plant communities. These communities consist of species that are the most salt tolerant in the central areas to the least salt tolerant at the edges. In Oman, about 15 halophytic species are common in coastal and inland *sabkhas*, and another 15–20 species that are tolerant of saline soils but not at the same extent as those associated with *sabkhas*. This constitutes about 4% of the total flora of Oman. Annuals are rare, and when present come up after heavy rain or are found near irrigated areas. Low shrubs such as *Limonium stocksii* (Arabic:

gesib), *Cyperus conglomeratus* (Arabic: *a'shey, ashayish*) and *Urochondra setulosa* are effective at binding wind-drifted sand that collects at their base forming small mounds called *nebkhas*, which provide shade and moisture from dew, and support a variety of animal life. Ephemerals also tend to germinate and grow on *nebkhas*.

Apart from the complex physiological adaptations of salt-tolerant plants, salt-secreting glands such as those found in the leaves of the *Atriplex* (Arabic: *raghlah*), *Limonium, Tamarix* (Arabic: *athal, terfal*) and mangroves (Arabic: *qurm*), and leaf or stem succulents as found in *Arthrocnemum* (Arabic: *teb*), *Halopeplis* (Arabic: *gharaiza*), *Suaeda* (Arabic: *hamdeh, harm*) and *Zygophyllum* (Arabic: *tharmed*) species are the more common adaptations, which are found on the Barr Al Hikman peninsula.

Salt-excreting glands are found in several Omani halophytes, which function by having specialised hairs on their leaves. Each hair has a stalk and a balloon-like tip, and the leaves excrete the extra salts in their bladder cells, which rupture when full, releasing the salt back into the environment. Examples are mangroves (*Avicennia marina* – Arabic: *qurm*) which, in Oman, are found in patches all along the coast, and the *Limonium* species. If you touch the leaves of these plants you can feel (and taste) the excreted salt crystals.

The extensive coastal and inland *sabkhas* of Oman provide us with a venue that can be used as an open laboratory in which to study and understand the dynamics of plants growing in stressed environments, in particular the hyper-arid, saline environments that characterise these areas. Most crop plants are very sensitive to salinity, their growth being severely inhibited by salt concentrations considerably less than exist sea water. In contrast, halophytes survive salt concentrations equal to or greater than that of sea water. The sensitivity of plants to soil salinity has important consequences for agricultural and fodder plants, especially in warmer, drier regions of the world.

Left: Halopeplis perfoliata, Barr Al Hikman.

Right: Atriplex leucoclada. Barr Al Hikman.