Dunes of the Namib Sand-Sea. The vegetated clumps of grass in the inter-dune valleys are speargrass (*Stipagrostis sp.*). Speargrasses have hairy leaves, designed to trap fog water and channel it down to the roots buried deep in the sand.

Wonders of the Namib Desert

You might think that nothing exists in a desert? Think again! The Namib Desert is teeming with life if you look closely.

The Namib Desert lies along much of the coast of Namibia, north of South Africa. This coastal desert is a land of two halves. The northern part, from the Kuiseb River to the Angolan border, is mostly a flat gravel desert. The southern part, from the Kuiseb River to the South African border, mainly consists of sand dunes (called the Namib 'Sand-Sea').

The climate of the Namib Desert is unique. The coast of the Atlantic Ocean that lies next to the desert is regularly covered with fog, which rolls in from the sea overnight and can travel inland for up to 60 km. Many of the coastal desert species, both plants and insects, are specially adapted to capture fog water.

The gravel plains of the hyper-arid central Namib Desert

When you look at the Namib desert, the gravel plains and sand dunes appear to be hot, dry and empty wastelands. Nothing could be further from the truth!

Both the plains and dunes are teeming with life! Some of this life is invisible to the naked eye; some of it is hidden by camouflage or by burrowing; and some of it is large and obvious.

The large and the obvious

The macrofauna and flora of the Namib Desert are famous. There is the stately oryx (a large antelope) that stands out on the golden dune sands, silhouetted against the sky. Oryx herds range widely across the entire desert, moving to where there has been rain and the growth of fresh grass.

One of the Namib's special inhabitants is the mysterious welwitschia plant (*Welwitschia mirabilis*). The welwitschia is restricted to a narrow inland stretch of land from southern

Oryx on the dune crest – a behaviour to promote cooling

A mature welwitschia (male) plant

Namibia into southern Angola. These slow-growing plants, ancient relatives of the pine tree, are dotted across barren and rocky landscapes, seemingly surviving the extremes of heat and desiccation with apparent ease. Their style of growth is very unusual. They have elongated fibrous 'leaves' that squeeze outwards from a woody stump. They can grow up to several metres long (if not eaten by oryx or mountain zebras!)

The Namib hosts many other drought-resistant trees and plants that are all adapted in some way to survive in an environment where precipitation is limited and intermittent. Coastal species, like the colourful lichens, adsorb water from morning fog. The dune-living tree called !Nara is also a fog-trapper, and protects itself from grazing animals with its sharp thorns. The !Nara have traditionally played an important role for the Namib Desert tribes, providing fruit as a source of water and nutrients.

The 'fairy circles' of the Namib Desert are a phenomenon of wonder and argument across the world. The origins of these enigmatic circular patches of bare ground, surrounded by 'lush' desert grasses, have been a matter of speculation for centuries.

The indigenous peoples of the Namib thought that they were the work of dragons. Recent scientific theories about their origins include the actions of UFOs, radioactive hot-spots, poisonous residues of dead *Euphorbia* plants, the presence of colonies of sand termites or infective fungi, or the result of complex and natural ecological interactions. But the true cause of fairy circles remains a mystery!

The hidden

Much of the life in the Namib Desert is hidden from our sight. Days are so hot that many insects, rodents and other small animals are nocturnal and feed at night. If one takes an early morning walk on the dunes, there is plenty of evidence of their night-time activities. Fascinating tracks lay in the sand.

The golden mole, one of the apex (top) predators in the dunes, forces a shallow sub-surface tunnel through the sand until it detects an insect on the surface. Moles have very acute hearing and when it hears the insect on the surface, the mole emerges from its tunnel, a scuffle ensues, and the mole dives back into the sand as soon as it has finished dinner. The moles spend all day buried deep in the sand, hidden from sight and protected from the heat and drying effects of the sun.

Other species rely on camouflage. Many of the desert species, of all sizes, are a sandy brown colour to help them blend in with the terrain. For example, the stone grasshopper looks exactly like the pebbles around it.

Most microbial life is microscopic and invisible to the naked eye. But, in special settings, microbial life can come together

The coastal lichen field north of Swakopmund. The orange foliose lichens adsorb water from morning fog events.

Foliose lichens in the lichen field, capable of adsorbing water from morning fog events

***Moringa ovalifolia* tree adapted to the extreme desert environment. Note the enlarged trunk at ground level, adapted to store water.**

to form visible macroscopic structures — like in the moister areas of the Namib where there are biological soil crusts on the desert surface. These are complex groupings of lichens, green algae and cyanobacteria (green photosynthetic filamentous bacteria).

In the more arid areas of the desert, life moves underground beneath quartz rocks and pebbles. These microbial communities are termed 'hypoliths' ('under', 'rock') and are invisible from the surface. Turn over a quartz rock embedded in the desert pavement, and you are greeted by a black/green crust stuck to the rock surface and at the rock-soil interface. Hypolithic communities are dominated by cyanobacteria, but can contain bacteria, fungi, viruses and phage, and even invertebrate 'grazers' such as springtails. The hypoliths are the 'tropical rainforests' of the Namib Desert.

The hypolithic niche is a much less extreme environment than the exposed soil surface. The overlying quartz is translucent, allowing light to penetrate to the sub-surface and supporting cyanobacterial photosynthesis, which in turn supports all the other species in the 'under rock' community.

The invisible

The most numerous yet invisible inhabitants of the Namib Desert are the soil microbes. Each gram of soil may contain

***!Nara* plant growing in Namib dune sands.**

***!Nara* melons are an important subsistence resource for the Topnaar community living along the Kuiseb**

millions of microorganisms, such as bacteria, archaea, fungi, viruses and phage.

During the long, dry periods between the infrequent rains in the desert, many of these organisms are dormant, with little or no metabolic activity. However, recent research has shown that a small fraction of the microbial species in dry desert soils retain some metabolic activity: slowly acquiring carbon by degrading lipids and nitrogen by reducing nitrate (nitrate is often present at quite high concentrations in the driest desert soils). The very latest research suggests that some desert soil microbes might make their own water by oxidising atmospheric hydrogen,

A flowering *Hoodia currorii*. Once thought to be an appetite suppressant (now disproved), Hoodia is widely sold as a health food product

Fairy Circles scattered across the sands of the eastern Namib Desert

The nocturnal activities of the burrowing Golden Mole. Mole tracks are everywhere in the dune sands, but the moles are very rarely seen above ground. Inset: The Namib Golden Mole, the "shark" of the dunes.

which generates energy to drive other processes in the cell.

Water in the desert

Water, or the lack of it, is what makes a desert. The aridity of a desert is determined by the ratio of precipitation to evapotranspiration. In deserts such as the central Namib, where precipitation is very low (an average of a few mm of rain per year) and the heat of the desert induces a very high evapotranspiration rate, the desert is classified as 'hyper-arid'.

Yet, a desert can burst into life when it rains. In early 2011, the central Namib Desert received over 70 mm of rain over

A Toad Grasshopper (*Trachypetralla andersoni*) camouflaged in the desert pavement

a few weeks. In the following month, the desert came to life with a sea of knee-high *Stipagrostis* grass. For a short time, the desert was a prairie, attracting herds of oryx, mountain zebra and springbok, and millions of seed-eating grey-backed sparrow-larks.

Research in the Namib Desert

The Namib Desert is a haven for scientific research. The unique climate, the fascinating and varied geology and the diversity of specialised fauna and flora of the desert offer wonderful opportunities to scientists.

The Gobabeb-Namib Desert Research Institute (the 'Station') is perfectly positioned in the heart of the desert and at the interface of the gravel plains and sand-sea zones. The Station has been supporting scientists from all over the world for more than 70 years and has made significant contributions to the global understanding of desert ecology.

Prof Donald Cowan from the Centre for Microbial Ecology and Genomics, University of Pretoria and his team have been working on research projects in the Namib Desert since 2010, first with Dr Mary Seeley (Director: 1970-1998) and, since 2013, with Director Dr Gillian Maggs-Kölling at the Gobabeb-Namib Research Institute, Walvis Bay, Namibia.

Ungacabana ukuthi akukho mpilo ogwaduke? Cabanga futhi! Ugwadule lase Namib lugcwele impilo uma ubukisisa kahle. Indilinga ye Fairy, I mole esagolide kanye nezinyamazane, konke lokhu ezinye zezinto zemvelo ezinhle ongazithola khona.

Translated by Zamantimande Kunene, South African Medical Research Council

CURRICULUM CORNER

LIFE SCIENCES: GRADE 10-12

- Diversity, change and continuity
- Biodiversity and classification
- Biosphere and ecosystem

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