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Treasure of ancient pollen

PREDICTIONS: FOSSILISED GRAINS REVEAL PAST AND FUTURE CLIMATES

Grasslands are a primary vegetation, not degraded forest land as first thought.

Citizen reporter

Ancient pollen grains found in sediment cores dating back thousands of years are helping scientists to shed light on the earth's past and future climates.

Dr Lynne Quick, a palynologist at Nelson Mandela University, who is currently working on the development of new paleo-environmental records in southern Africa says there's much more to pesky pollen and fungal spores that wreak havoc on those with allergies.

"Pollen is distinct in two ways. It has a unique shape, depending on what plant it comes from, and its outer layer is made of sporopollenin, which is chemically very stable and resistant to microbial decay. In fact, it's one of the most chemically inert organic compounds found on earth and is known as the 'diamond of the plant world'. Sporopollenin preserves pollen grains in ancient deposits and sediments when almost all other organic materials are reduced to unrecognisable components.

"When pollen is washed or blown into bodies of water and sinks, their walls remain intact, which allow them to remain preserved in sediment layers in the bottom of lakes, oceans and wetlands. Their unique shape enables us to identify what plant species were in abundance at the time the sediment was deposited and, through carbon dating, we can determine the age of the fossilised pollen." Quick says.

"Knowing what types of vegetation were growing in an area allows us to make inferences about the climate at that time. This is because plants have bioclimatic niches, which means they can only live and thrive under certain climate and environmental conditions. Fossil pollen leaves an important fingerprint that can help us uncover how our climate has changed over millennia and what it may look like in the future," she explains.

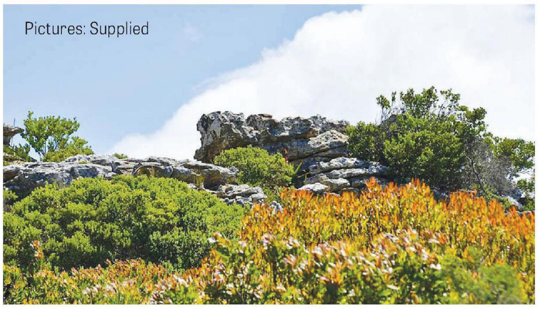
There is a large body of work that covers the reconstruction of landscapes and environments using pollen evidence from thousands of years ago of different parts of South Africa. Most of the data generated by Quick and other researchers are incorporated into climate and bioclimatic models as baselines for past vegetation changes, which can also aid in environmental conservation management initiatives.

She says with future climate change, significant shifts in vegetation distributions are likely to occur, which may threaten the high levels of species richness and endemism found within some of SA's unique biomes.

These predictions are based on the outputs of bioclimatic models, which require the use of palaeoecological data, such as fossil pollen records, to test the strength of the projections and validate the climate-vegetation hypotheses inherent within these models.

Key regions of interest in South Africa, include fynbos (Western Cape and Eastern Cape), Drakensberg (KwaZulu-Natal), grassland (high central plateau of SA and inland areas of KwaZulu-Natal and the Eastern Cape) and savanna biomes (Free State, North West and Gauteng).

TRENDS. Savannah may be compromised by the effects of CO2 fertilisation, which are likely to increase the growth rate of trees to the detriment of grasses.



CYCLES. Scientists predict that a warmer, drier future climate may threaten the high levels of fynbos species found in the Western Cape.

Based on fossil pollen dating back 10 000 years, the Cape floral region was once abundant in both fynbos and forest, indicating plenty of rainfall and moisture, while future predictions suggest a much warmer and drier climate for the Western Cape.

"It is expected that the extent of forest areas will be reduced to isolated patches where conditions remain favourable, along with potential reductions in the extent of the fynbos biome," says Quick.

"In addition to the threat of climate change, ongoing habitat transformations (as a result of agricultural, coastal resort and urban development) and the rapid spread of alien vegetation, makes the region particularly vulnerable to significant reductions in biodiversity. To limit the impact, the conservation of the coastal lowlands of the fynbos biome should be prioritised."

The Drakensberg mountain range also has immense ecological significance, because of the great plant biodiversity found there.

Ongoing pollen research from high altitude wetlands conducted by Dr Jemma Finch and Prof Trevor Hill from the University of KwaZulu-Natal has been used to reconstruct long-term vegetation dynamics and associated climate change.

"Their research indicates that grasslands found in the area, which were traditionally viewed as secondary features of the mountainous terrain – a degraded vegetation type resulting from forest clearance and burning by prehistoric people – is actually an ancient primary vegetation type."

Of particular interest in this region is the integration of pollen data with the more traditional archaeological records that trace human occupation. Pollen records from the Drakensberg and surrounds reveal that grasslands remained relatively stable over the past 5 000 years, whereas forests were restricted in their distribution, likely occupying fire-protected valleys and kloofs as seen in the present-day grassland-forest mosaic.

Quick says the long-term perspective provided by this pollen research highlights the conservation value of grasslands as an ancient and primary vegetation type dominating this important watershed.

"As the climate continues to warm through the 21st century, there are concerns that montane grassland species may be forced to respond by migrating upslope, altering the composition of these important grasslands and impacting species that may not be able to keep pace with the current rate of environmental change."

Analysing pollen in soil from Southern African savannas shows varying changes in rainfall and warmer periods that have influenced vegetation changes in the last 6 000 years. Scientists say these landscapes might be compromised by the effects of CO_2 fertilisation, which will increase the growth rate of trees, allowing more rapid access to water in deep soil layers to the detriment of grasses. This effect is currently being aggravated by escalating illegal hunting of mega-herbivores, such as the white rhino, historically important in keeping tree canopies open.

The loss of open, grassy landscapes has implications for grazers and other flora and fauna adapted to these environments and may be detrimental to wildlife tourism as it will decrease game viewing potential. According to Quick, palaeoecological data, such as pollen records, can increase our understanding of ecological responses to both natural and human-induced impacts and can help to design appropriate restoration practices and stewardship programmes.

"Through this deep-time ecological lens we can see that grasslands are not degraded forms of landscapes. Therefore, we should carefully consider the implications of planting trees and expanding forests as these efforts may undermine the provision of valuable ecosystem goods and services associated with grasslands."

She says the study of both ancient and present-day pollen are crucial as it will help to inform future climate models and conservation efforts.

However, the funding thereof remains problematic and hinders the work scientists do. More than R1 million is needed annually to fund pollen monitoring.

The last 20 years of pollen monitoring in the Western Cape has provided crucial answers about the rate and extent to which climate change is occurring. Researchers have noticed fluctuations in pollen seasons, which are starting earlier and ending later than before. – *news@citizen.co.za*

info

Allergies

- ▶ Pollen forecasting is becoming increasingly important as GPs and allergists rely on the data to provide effective care to patients.
- ▶ Being aware of high pollen counts allow patients to avoid exposure and prompts them to take preventative medicine.
- ▶ The above average rainfall for the Cape in the past two years has caused a surge in not only tree pollen levels, but allergenic tree counts have been higher.

ON THE JOB. Dr Lynne Quick and her team extract sediment from wetlands.