Metals from urban pollution are contaminating the last few old forests in Cape Town

By Anne-Liese Naude (Kruger)

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Forests are good for the planet: they purify the air and moderate the climate. They are abundant in resources, providing habitat, food, shelter and a rich biodiversity of plant and animal life.

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So it's a worry that forests located near major cities are exposed to metals commonly found in atmospheric pollution. Metal contamination is one of the most serious environmental pollutants because it's toxic and gets into air, water and soil.

Metal contamination in forest soils affects biological activity. It causes delays in the decomposition process, which provides essential nutrients for the growth of plants and organisms. Plants can also be damaged, causing disruption in photosynthesis and transpiration processes. This can affect carbon storage and sequestration and consequently the climate.

Every day, metals such as manganese, copper and zinc are released into the atmosphere through natural and human activities. Some of the major culprits are urban living: vehicle traffic, industries, construction sites, burning of fossil fuels for heating and cooking and also contaminated dust that's resuspended from urban surfaces into the air.

All of this puts particles of matter into the atmosphere. In winter, especially, this matter becomes concentrated and appears as a brown haze, indicating severe pollution.

This is a common occurrence in the city of Cape Town, South Africa. The brown haze was observed in 1990 for the first time and was visible for only 15 days. The episodes have increased since then and become more intense. The brown haze is now visible from April to September.

To get a better idea of whether the city's forests are threatened by this apparent rise in pollution, we studied the soil, leaf litter and key organisms commonly found in these areas.

Our study looked at two forests close to Cape Town and compared them with a forest further away. In the closer forests, we found higher concentrations of manganese, copper and zinc arising from pollution generated in the city. The information from studies like this can help people act to prevent irreparable damage to the environment.

Protecting forests means protecting a rich biodiversity of plants and animals and their habitats, medicinal plants, the livelihoods of many people, the climate, the soil, the water and the air.

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Cape Town's indigenous forests

The two forests close to Cape Town – Newlands and Orange Kloof – are pockets of ancient Afromontane on Table Mountain. This mountain is globally known for the extraordinarily rich, diverse and unique fauna and flora.

About 200km from the city is an ancient indigenous forest, Platbos. Indigenous forests are the smallest biome in South Africa and cover only 0.56% the country's land surface.

At these sites, we measured the levels of manganese, copper and zinc in soil, leaf litter, moss, lichen and pill millipedes. These organisms are commonly found in the Afromontane forest pockets and play an important role in the forest ecosystem. They absorb carbon dioxide, provide habitat, shelter and food for small animals, and are good indicators of pollution.

Moss is also important in regulating water and preventing soil erosion. Pill millipedes turn decayed plant material into humus, making nutrients such as nitrogen and phosphates available for plant and tree growth.

The highest metal concentrations were found in Newlands forest, closest to the city, and the lowest metal concentrations were in the Platbos forest, furthest away from the city. The manganese, copper and zinc concentrations measured varied from minimum of two times higher than Platbos to about 19 times higher than Platbos.

Most of the metal concentrations measured were below acceptable levels generally found for soil and plants. The relationship between urban areas, high traffic activity and pollution patterns were, however, clear and should be monitored in a growing city.

The forest pockets on Table Mountain are situated in remote areas, high and deep into the mountain. One would think that these ancient hideaways were safe from the impact of pollution generated from the city. But the results showed that the parts of the forest that are closer to heavy traffic or air pollution are indeed affected, as metals are able to travel long distances.

Forests are already becoming vulnerable to climate change, excess pollution, agricultural expansion and deforestation. While the forest canopies are removing air pollutants, because part of the function of the forest ecosystem is to purify the air and water, they are at the same time intercepting aerosols containing metals.

These collect in the vegetation and soil via precipitation or litter fall. Forest soil is a habitat that is considered one of the most diverse on earth, comprising the most diverse combinations of living organisms.

Soil biodiversity is the force behind ecosystem services such as soil formation, nutrient cycling, carbon sequestration and food production. It also helps control pests, purify water and break down pollutants. Forest organisms and soil biodiversity depend on healthy ecosystems for survival.

Contaminated forest soil could therefore disrupt ecosystem services, which in turn could result in species loss and die-back of trees and forests. Soil is a non-renewable resource, so contamination is a global conservation concern.

Protection is first and foremost

Protection of the forest biome is a priority to sustain its ability to absorb air pollution. Pollution can be minimised merely by lessening the burning of wood and garbage, as well as preventing forest fires.

Vehicle exhaust is one of the biggest sources of pollution and can be reduced by reducing vehicle trips and using public transport. Manufacturing industries are also a huge source of air pollution. Recycling and reusing materials to minimise production can help here.

Cape Town houses a critically endangered biodiversity of global importance and realises that conserving the biodiversity is a key challenge. As a growing city, urbanisation is causing extremely high pollution. The city's Environmental Quality Management Strategy is aimed at reducing carbon emissions, implementing adaptation measures to ensure the future resilience of the city, exploring cleaner fuel options and improving the existing recycling programs.

Professors James Odendaal and Reinette Snyman also contributed to the research.

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