

Desert-loving fungi and lichens pose deadly threat to 5,000-year-old rock art

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Negev petroglyphs of animals. Credit: Laura Rabbachin, INTK, Academy of Fine Arts, Vienna

The Negev desert of southern Israel is renowned for its unique rock art. Since at least the third millennium BCE, the hunters, shepherds, and

merchants who roamed the Negev have left thousands of carvings (petroglyphs) on the rocks. These figures are mostly cut into desert varnish: a thin black coating on limestone rock, which forms naturally. Many represent animals such as ibexes, goats, horses, donkeys, and domestic camels, but abstract forms also occur.

Now, a [study published](#) in *Frontiers in Fungal Biology* has revealed that the petroglyphs are home to a community of uncommon specialist fungi and lichens. Unfortunately, these species may pose a serious threat to the rock art in the long term.

"We show that these fungi and lichens could significantly contribute to the gradual erosion and damage of the petroglyphs," said Laura Rabbachin, a Ph.D. student at the Academy of Fine Arts Vienna in Austria, and the study's first author. "They are able to secrete different types of acids that can dissolve the limestone in which the petroglyphs are carved. In addition, the fungi can penetrate and grow within the stone grains, causing an additional mechanical damage."



Petroglyph showing human figure. Credit: Laura Rabbachin, INTK, Academy of Fine Arts, Vienna



Negev petroglyphs showing abstract forms. Credit: Laura Rabbachin, INTK, Academy of Fine Arts, Vienna



The landscape around the petroglyphs in the Negev desert. Credit: Laura Rabbachin, INTK, Academy of Fine Arts, Vienna

Extreme conditions

Rabbachin and colleagues took samples from a [petroglyph](#) site in the central-western highlands of the Negev. Here, an average of just 87mm of rain falls per year, and temperatures on rock surfaces can soar up to 56.3 °C in summer. The researchers scraped samples from desert varnish next to petroglyphs, from rocks without desert varnish, and from soil near the sampled rocks. They also left petri dishes open near the rocks to capture airborne spores.

The authors identified collected fungi and lichens with two complementary methods. First, they repeatedly cultured fungal material or spores from rocks or soil on plates with one of two different growth media, until they obtained pure isolates for DNA barcoding. Second, they directly performed DNA sequencing of fungal material present in rock or [soil samples](#), without culturing them first. The latter method can detect strains that don't grow in culture.

Few but destructive species on petroglyphs

Both methods showed that the diversity and abundance of species on rocks bearing petroglyphs was low in comparison with the soil, which suggests that few species are able to withstand the local extremes of drought and temperature.

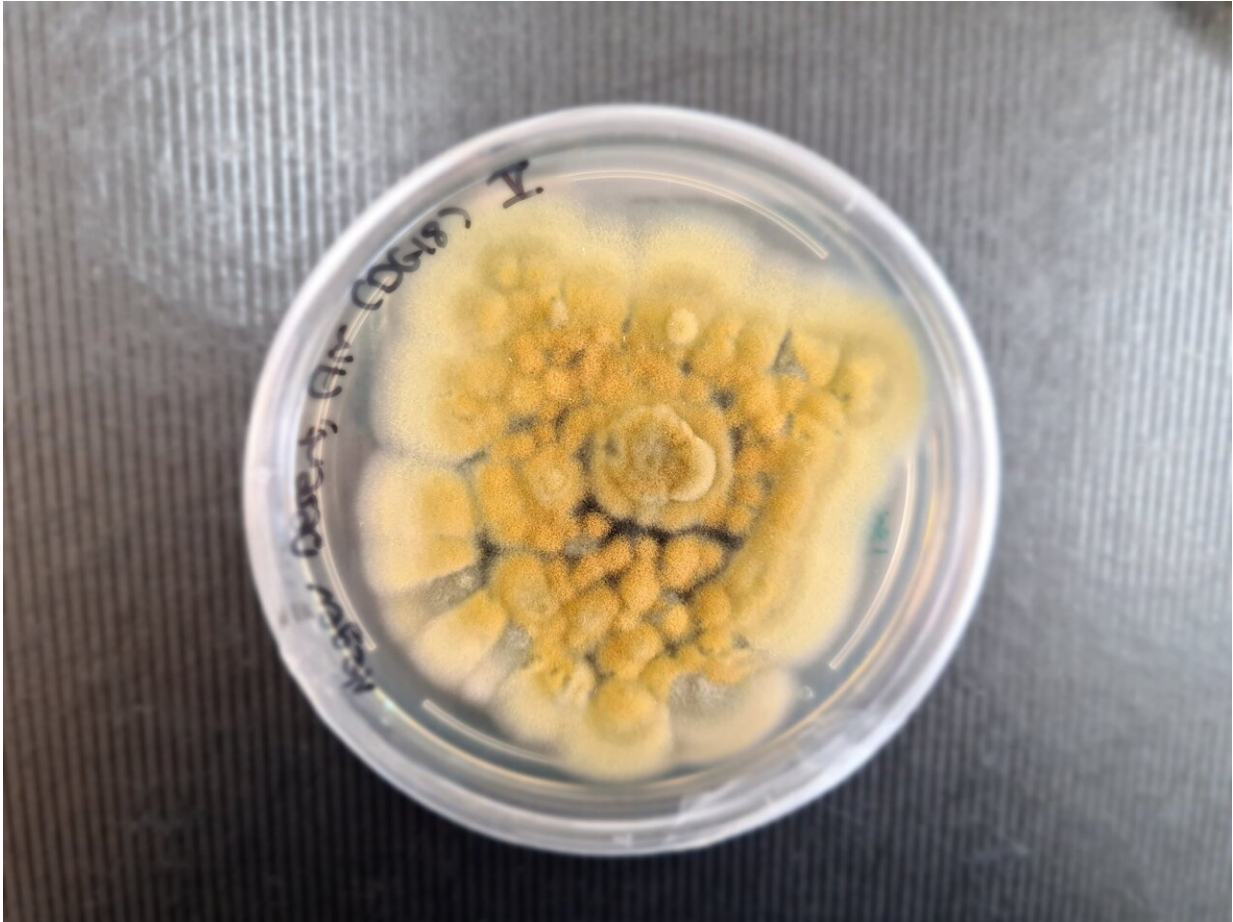
DNA barcoding of cultured isolates revealed that the petroglyphs harbor multiple species of fungi within the genera *Alternaria*, *Cladosporium*, and *Coniosporium*, while direct sequencing further detected multiple species in the genera *Vermiconidia*, *Knufia*, *Phaeotheca*, and *Devriesia*. All except *Alternaria* and *Cladosporium* are so-called microcolonial fungi, known to thrive in hot and cold deserts around the world. Also abundant were lichens in the genus *Flavoplaca*.



Fungus culture: *Alternaria* sp. NS4. Credit: Laura Rabbachin, INTK, Academy of Fine Arts, Vienna



Fungus culture: conidia of *Alternaria* sp. NS1. Credit: Laura Rabbachin, INTK, Academy of Fine Arts, Vienna



Fungus culture: *Cladosporium limoniforme*. Credit: Dr. Irit Nir, Ben Gurion University of the Negev

"Microcolonial fungi are considered highly dangerous for stone artifacts. For example, they have been implicated as a probable cause of the deterioration of stone [cultural heritage](#) in the Mediterranean," said Rabbachin.

"Lichens are also well known to cause rocks to deteriorate and thus to be a potential threat to stone cultural heritage."

In the surrounding soil and air, the researchers mainly found different,

cosmopolitan fungi, which are known to be able to survive harsh desert conditions through the production of drought-resistant spores.

Documenting threatened rock art is a necessity

Can anything be done to protect the petroglyphs from the slow but destructive work of the observed microcolonial [fungi](#) and lichens? This is unlikely, cautioned the authors.

"These natural weathering processes cannot be stopped, but their speed of the weathering process depends heavily on whether and how the climate will change in the future. What we can do is to monitor the microbial communities over time and most importantly, document these valuable works of art in detail," said Rabbachin's academic supervisor, Prof Katja Sterflinger, the study's senior author.

More information: Diversity of fungi associated to petroglyph sites in the Negev desert, Israel, and their potential role in bioweathering, *Frontiers in Fungal Biology* (2024). [DOI: 10.3389/ffunb.2024.1400380](https://doi.org/10.3389/ffunb.2024.1400380)

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