Atacama Desert: Some lichens can meet their need for water from air humidity

The Atacama Desert in Chile is one of the most arid places on earth. To survive here, lichens use fog, dew and high humidity. For some of them, the high humidity alone is sufficient to carry out photosynthesis. This is at least the case with lichens, which sit on cacti. Their relatives on the ground are not able to accomplish this. This is the result of a study by researchers around Dr Patrick Jung from Technische Universität Kaiserslautern (TUK), Germany, published on the online portal "MicrobiologyOpen". These lichens can therefore be active for a longer period of time. During their work in the Chilean desert, the researchers also discovered and described a new species of lichen.

The Atacama Desert extends in the east of South America on a high plateau along the Pacific coast. Water vapour regularly rises here on the steep rocky coasts. In the form of fog, also called camanchaca, it finally moves inland. “These oases of fog contain many cacti and above all lichens,” says Dr Patrick Jung, first author of the current study and scientist in the Department of Plant Ecology and Systematics at TUK. Lichens resemble symbiotic organisms of at least one fungus and at least one algae carrying out photosynthesis. These can be green algae or cyanobacteria.

"We wanted to know how lichens use fog and high air humidity as water sources, since rain plays no role here," says Jung. If there is no water available, lichens fall into a resting state in order to save energy. For their study, the scientists compared lichens on the ground with their conspecifics that grow on cacti. In the professional world, such organisms are also known as epiphytes.

“They usually have a bearded structure that hangs down from the cacti,” Jung describes the lichens. "The water of the mist gathers in it and falls as a drop to the ground, which is then used in turn by the cacti."

The research team measured the photosynthetic activity of the lichens as the fog passed over the plateau. They used a measuring device that shoots flashes of light at the lichens. Since lichens use a portion of the light for photosynthesis, only a portion of the light leaves the lichens again. This ratio depends on the water content of the lichen. “With these difference values we can determine how high the potential photosynthetic activity of the lichens is,” explains Jung.

The team around the Kaiserslautern botanist found out that the plants use the fog water very efficiently: "After only three minutes, they start to be photosynthetically active." This applies both to the species on the ground and to those on the cacti. In another experiment, they studied how lichens make use of high air humidity, which can also be over 90 percent at natural sites. The study has revealed that only epiphytic lichens use such as water source. "We still have no idea what the reason is,” Jung continues. "The lichens on the cacti have a clear advantage over their conspecifics on the ground, because they can be active by not only exploiting fog and dew but also high humidity over a longer period of time." Therefore a variety of cacti covered with lichens and relatively few lichens that colonize the ground can be found in this fog oasis. This is also why many epiphytic lichens form the food basis of the native guanacos, a small camel species, and represent an important link in the food ecosystem of the barren landscape.
In their work, the botanists also sequenced the lichens genes and discovered a new species. They named this new yellow lichen Acarospora conafii. “The name derives from Conaf,” says the Kaiserslautern researcher. The abbreviation stands for the Chilean Forest Authority (Corporación Nacional Forestal), which supported the research. Their rangers also take care of the National Park “Pan de Azúcar”, which is located in the Atacama Desert and where the team around Jung studied the lichens.

The study has been published on the online platform MicrobiologyOpen: „Ecophysiology and phylogeny of new terricolous and epiphytic chlorolichens in a fog oasis of the Atacama Desert“

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Credit: Patrick Jung
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