What Darwin couldn't see: Expedition to uncover invisible life in Galápagos

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Giant daisy trees in the cloud forests of Floreana, one of the Galápagos isles... yes, these are actual trees. Credit: Gonzalo Rivas-Torres

An international research team led by the Netherlands Institute of Ecology (NIOO-KNAW) is to search for invisible life in the Galápagos Islands. The diversity of bacteria and other microscopic organisms may not be evident to the naked eye, but it is essential to nature; for example, to the islands' giant daisies, unique endemic plants that are currently under threat.

How unique and diverse is the invisible microbial life of the iconic Galápagos Islands? That's what the Galápagos Microbiome Project—a group of scientists from the Netherlands, Ecuador, Spain and Brazil—intends to reveal. It could improve our understanding of the co-evolution of species. In this case, the researchers plan to sample both bacteria and fungi (the microbiome) and their host plants.

"It's really motivating for us to follow in Darwin's footsteps and profile the diversity of microbes on and inside of wild plant species," says project leader Jos Raaijmakers, head of Microbial Ecology at the Netherlands Institute of Ecology (NIOO-KNAW) and professor at Leiden University.

Giant daisy, the Darwin's finch of plants

Insights from the expedition could make an important contribution to the preservation of endangered plant species, including Scalesia, the giant daisy. It's found on the uninhabited islands in the archipelago in particular. Scalesia grows on fertile soil, which is in great demand for agriculture outside of nature reserves. Other threats to these unique endemic plants are grazing goats, invasive plant species and extreme climate conditions.

Scalesia has been called the Darwin's finch of the plant world. Just like the famous group of bird species Darwin found in Galápagos and used as inspiration for his theory of evolution, the members of the Scalesia

family differ substantially between sites and between islands. It's a modest shrub growing among pumice stones in one place, but a veritable tree surrounded by cloud forest in another. Adapting to local circumstances, Scalesia developed a huge variety that has resulted in at least 15 different species.

Micro-friends

But how about the micro-organisms? Did they, too, adapt and develop great diversity across the islands? And what is their role in the ecology of the endemic host plant? Finding out more about the plants' as yet unknown microbial partners will hopefully turn out to be the key to supporting their growth and survival.

"It's an invisible world that would have been impossible to study in such detail in Darwin's day," Raaijmakers explains. "Current DNA-techniques allow us to unravel the diversity of microbes, and study if it is in line with their host plants' speciation on different islands in the archipelago."

Scalesia in bloom, seen from up close in Galápagos. Credit: Gonzalo Rivas-Torres

By ship

The international team comprising six researchers and a filmmaker will start their 12-day expedition to a number of Galápagos Islands on 25 March, using their ship as a base. Project leader Raaijmakers has been working closely with Pieter van 't Hof and Gonzalo Rivas-Torres from the Universidad San Francisco de Quito in Ecuador to make the search for the different species of giant daisy possible. These researchers and their team have ample experience when it comes to expeditions to

Galápagos, and they play a key role in the Galapagos Barcode Project, an ambitious undertaking that aims to document the genetics of all species on the islands and in the surrounding waters.

"We will be sampling the leaves and roots of the plants to profile the microorganisms living there," says Raaijmakers. "Just like people and animals, plants depend on microbes for their growth, development and health. We have billions of microbes on our skin and in our gut with which we co-exist. Plants have a similar microbiome: billions of beneficial bacteria, fungi and yeasts in and on their roots and leaves."

These will not be the first plants sampled by Raaijmakers and his fellow researchers. "For a number of crop plants, we already have a fairly good overview of their microbiome and that of their wild ancestors. But so far, we only have a partial understanding of the diversity of functions we observe there," he says. It will be exciting to make comparisons with these wild species and their micro-friends. "Also, beneficial plant microbes may in the long run play a key role in preserving and restoring native species threatened by climate change and invasive plants," he adds.

What is so special about the Galápagos Islands?

The largely uninhabited Galápagos Islands are surrounded by open sea, about 1,000 km west of South-America. Because of their remoteness, animals, plants and possibly microorganisms have evolved independently from their counterparts on the mainland. The huge variety of closely-related species helped Darwin, who visited the islands in 1835, to develop his theory of evolution.

Much research has been done on the various islands into the occurrence of genetic variation within individual animal species, eventually resulting in an explosion of new species and subspecies, as was the case with

Darwin's famous finches. More recently, similar research has been done into native plants, with Scalesia displaying a similar variety: from small plant or shrub to tall tree. Trees are exceptional for the daisy and dandelion family.

Provided by Netherlands Institute of Ecology