SCIENCE
by Rebecca Priestley

Out of this world

The microbes in our geothermal springs could be biotechnological gold.

Some of our most unusual flora and fauna could live in the waters of the Taupo Volcanic Zone, says scientist Matthew Stott. And in a bid to catalogue these microbes, 1000 of the region's geothermal springs will be visited by a team of microbiologists from GNS Science and the University of Waikato, led by Stott, in the next two years.

Each hot spring is a unique ecosystem, with its own distinct temperature, acidity, salinity and mineral composition. Unusual microbes thrive in these high-temperature, mineral-rich environments that most species would find toxic. "While you and I breathe oxygen, micro-organisms in these hot springs might breathe in methane, or use carbon dioxide and hydrogen to make methane gas so they can breathe."

Micro-organisms – an overarching term that can refer to all microscopic organisms, including bacteria, archaea, protozoa, fungi and algae – are more than a scientific curiosity. As well as playing a crucial role in nutrient cycling in a range of different ecosystems, they also live in our bodies.

"A lot of what we see in the world around us is controlled by micro-organisms," says Stott. "It's only in the last 10 years that we've realised the human body is more micro-organism than human – there are 1-10 trillion human cells and between 10-100 trillion bacterial cells in every person."

It turns out the planet's greatest biodiversity, and more than half the total biomass – the combined weight of all species – comes from micro-organisms. But because they can only be seen under a microscope, this crucial part of our biosphere is largely unknown and undescribed.

Investigation of our geothermal microbes has already yielded a heat-loving bacteria capable of degrading cellulose and bacterial haemoglobin that some day may be used as the basis for a synthetic blood product. Internationally, geothermal environments have been a rich resource for bioprospectors. Taq polymerase, an enzyme discovered in Yellowstone National Park last century, revolutionised molecular research by facilitating the efficient replication of small strands of DNA in a technique known as polymerase chain reaction (PCR). This discovery won Kary Mullis a Nobel Prize in 1993 and has earned billions of dollars for the intellectual-property holders.

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Top, sampling the hot springs; above, some of the area's microscopic organisms.

Stott's research, which is funded by the Ministry of Business, Innovation and Employment, will lead to a searchable catalogue of what's in the Taupo zone's geothermal springs. As well as searching for unusual genetic sequences, users will be able to look for particular environments. "If someone's looking for an enzyme that breaks down methane and can work at 90°C, we could go through our list of hot springs and look for one that's got a lot of methane, is 90°C and has lots of bugs living in it."

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The first stage of the research is to "pull the bugs out of the water and look at the DNA", Stott says. New genetic techniques, including PCR, mean that within hours they can identify all the micro-organisms within a community. "All micro-organisms have a fingerprint we can compare to all other micro-organisms." Any novel or unique genetic sequences will immediately stand out.

At a time when the Taupo Volcanic Zone is being eyed for new geothermal developments and tourism ventures, it's important to do this research now.

"It is imperative that the regulators and power companies have all the available information to assess environmental impacts of any developments," says Stott. "Otherwise these 'unseen' biota with unknown conservation value and overwhelming biotechnological potential, may become an 'unseen' loss. And that kind of represents where we are with micro-organisms in New Zealand. It's an unexplored science. We're going out for a first look to see what's there before we destroy it." ▮

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