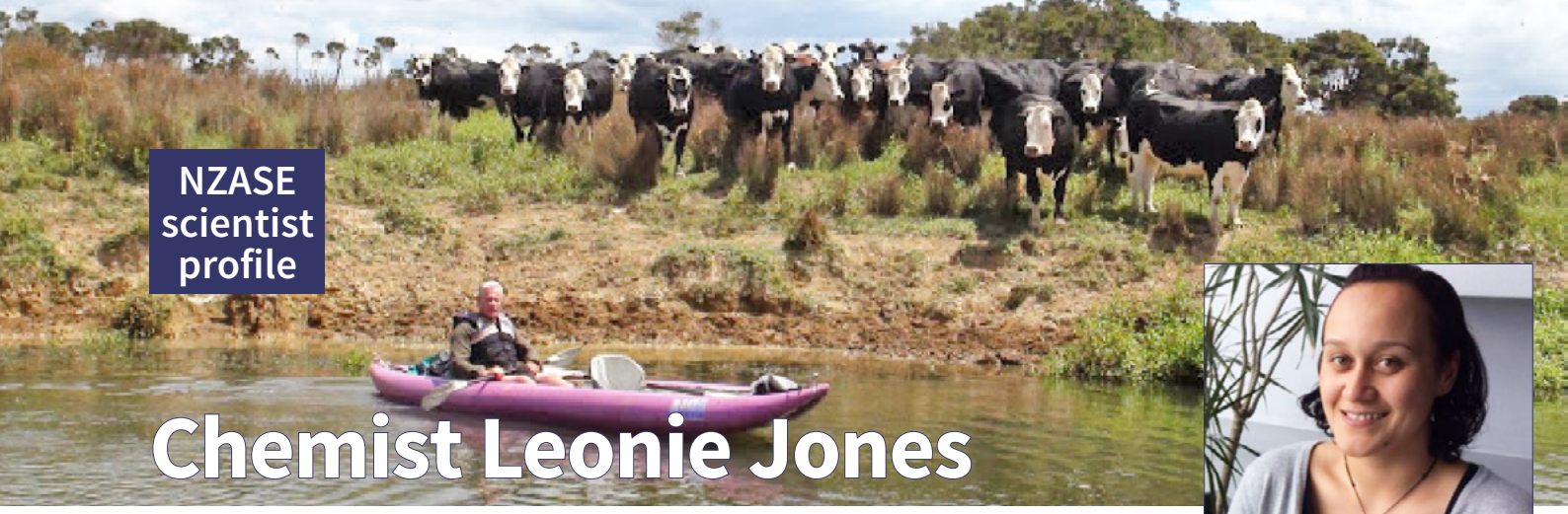
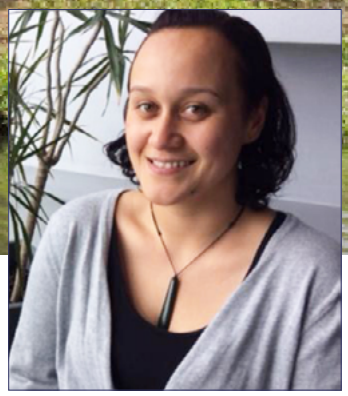


NZASE scientist profile

Chemist Leonie Jones



Millan Ruka of Environment River Patrol (ERP), by an unfenced paddock enabling pollution of Waikokopa Stream in Te Tai Tokerau. Photo: ERP. His work inspired Leonie, right, to develop a water quality sensor. Photo: National Science Challenges.

Born

South Auckland, 1984.

Affiliations

Ko Pūhanga Tohorā te maunga, ko Tāheke te awa, ko Tāheke te marae, ko Ngāpuhi me Ngāti Kahungunu ki Wairarapa ngā iwi.

School and subjects

Manurewa High School – chemistry, marine science, general science, statistics and calculus.

How she got into science

"Science was always a subject that came naturally to me. At high school I gravitated toward the technical subjects. They piqued my curiosity and seemed to fit with how my brain worked – logical, methodical, inventive, and creative.

"I was inspired by my high school teacher to pursue a PhD. He had a PhD in Chemistry and to my 15-year-old self, was the coolest teacher in the world. He could answer all my questions, gave me hands-on and interesting work, and had a depth of knowledge that made me think 'I want to be like that'. He was also the one who first introduced me to fullerenes.

"After school, I wanted to join the Navy and pursue marine science, but my mum insisted I attend university and pursue research. Her words are now my mantra: "Your mind thrives on learning and understanding. Use it, change the world."

Training and jobs

BSc in Marine Science and Chemistry, 2005; **BSc Hons** in Physical Chemistry, 2007; **PhD** in supramolecular crystal engineering, 2013, all at the University of Auckland.
Post-doctoral researcher, University of Auckland, 2014-5; **Research scientist**, Digital Sensing Ltd, Auckland, from 2015; **Owner**, OrigiNative Research Aotearoa, from 2021.

Fields of science

Marine science, chemistry, engineering.

Research topics

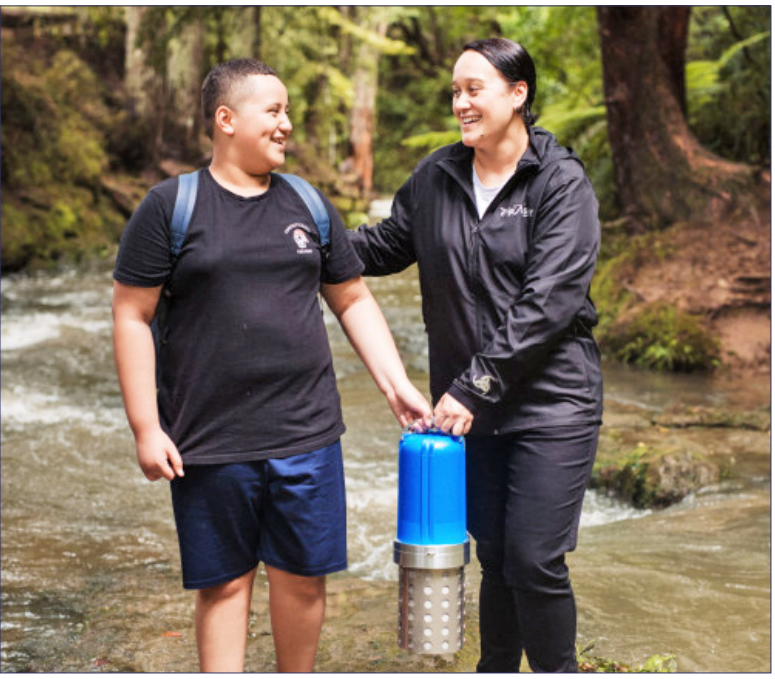
Computational chemistry

This theoretical branch of chemistry is used to study the structures, properties, and energies of molecules and solids. Nuclear magnetic resonance (NMR) imaging is a common tool. It places a substance in a powerful magnetic field, and by observing and measuring the interaction of the resulting nuclear spins, enables molecular structures to be analysed. For her BSc Honours, Leonie investigated how metals influence NMR.

Synthetic chemistry

Leonie's PhD in supramolecular chemistry studied the interactions of two types of big organic molecules, porphyrins and fullerenes.

"Fullerenes are like soccer balls and porphyrins are like donut rings. If you design and build them carefully, you can encourage them to come together in just the right orientation so that they harvest the most solar energy." She



Leonie and her son John-Paul with the DSL water quality sensor. Photo: National Science Challenge.

designed molecules computationally, synthesised them in the lab, grew crystals of the complexes, and investigated those assemblies.

"It's like architecture at a molecular level; you design huge complex structures to have certain attributes and activities, then you make them and test them to see if they work." Using the crystal structures of the complexes she built, she investigated the bonding interactions between the porphyrins and fullerenes.

"It's really cool when you get a new crystal structure that has never been made before, and you are able to fully characterise it physically and computationally."

Water quality

Leonie's university supervisor for her postdoctoral research also worked at Digital Sensing Limited (DSL), a company which develops sensors and diagnostics. In 2015, Leonie was awarded initial funding from Science for Technological Innovation to develop new sensor technology to monitor water quality. "This was around the time that two-thirds of our rivers had been declared unswimmable", she says.

She had also met Millan Ruka (Te Urioroi, Te Parawhau, Te Māhurehure), founder of Environment River Patrol Aotearoa, who worked to protect his ancestral Wairua River and other waterways in Te Tai Tokerau by taking photos, submitting reports to councils, and collecting water samples that took weeks to be analysed.

Leonie was inspired to develop real-time sensors that measured water quality and delivered the results remotely. "Existing water quality sensors were so expensive that you could only really afford to buy one; I wanted make them affordable so users could place several along a waterway. You also had to be a scientist to understand how to use them. I wanted to simplify them so that people like Millan could use them to protect the environment."

How she finds things out

"You need lots of background reading to keep up with new technology, concepts, and research results from around the world. But not everything gets reported in mainstream media or science journals, so you need to monitor social media to get a broad understanding of the state of things, as well as issues and problems that users face.

"Knowing your limitations is important. I surround myself with people from many disciplines with many different skills, for guidance, advice, training and help.

"Not all designs are successful. Even if they make complete sense theoretically, sometimes they just don't work in the field. You have to refine it, rebuild it, and test it again. You keep going. There is so much value in a fail – what you learn, the resilience you build, the strength you gain. Fails are part of the path to success."

Most valuable results

The DSL floating water sensors can track pollution levels at high resolution and in real time, wirelessly reporting them to a cloud database. The sensors aren't affected by the algae and biofouling common for in-situ environmental monitors.

"Real-time sensors help us see what's going on in the environment all the time, not just occasionally. They tell us when it's safe to swim and when it's not, when it's safe to harvest kai and when it's not, if the water is clean or contaminated.

"Farmers could use them in streams running through their fields to gauge how much nutrients are leaching from the soil. Organisations planting along rivers and lake edges can track their impact on water quality. Māori tasked with taking care of their environment can use them to track the health of their awa. There are lots of other uses." DSL teams are

now adding the ability to remove pollutants, like excess nitrates, from water.

Mātauranga Māori

Leonie says that her Māoritanga guides how she conducts herself and leads her research projects. She draws on the tikanga she was taught and implements it in every aspect, from designing projects to engaging and reporting to communities. She emphasises the importance of intergenerational thinking and connectedness, which is intrinsic to a Māori world view.

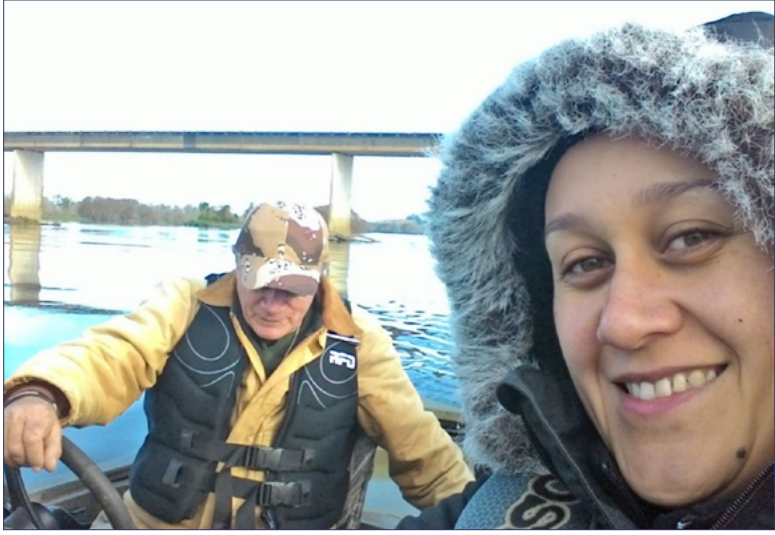
"I like to follow the reciprocity and collaboration expressed in the whakataukī 'mā te tuakana ka tōtika te teina, mā te teina ka tōtika te tuakana' (the older sibling leads the younger and the younger sibling leads the older). I'm extremely grateful to have kaumātua and kuia who guide me and impart their mātauranga. A cool part of my job is working with iwi and marae, co-innovating and collaborating."

"Science often requires us to see and analyse something in isolation. However, in a Māori view, we are never separate from the bigger system – we are all connected. So when you are designing new tech for the chemistry of a river, you must look at the water, the land, the air, the flora and fauna, the people, the history, the future, everything, not just the chemistry. This is a pretty awesome way to do science."

What she likes about science

"I really like doing things that people haven't done before; synthesising new molecules for a particular purpose, designing and building new devices for a particular function. I enjoy looking at a situation and thinking 'I can fix that' or 'I've got this idea for something that will solve that issue'. Inventing new solutions for real-world problems energises me and makes me happy.

"Working as a research scientist in a private company has its pros and cons, but I enjoy it. It means everything must be kept secret, so my research isn't widely published, and you can't google me and find out what I've made or discovered. I do feel the pull of 'blue skies' research – pursuing the unknown – but right now I am happy working in the private sector, researching, inventing, and innovating and taking my inventions to market. It's always fresh, challenging, and exciting."



Leonie's selfie of her and Millan near Rangiriri on the Waikato River.

Links

- National Science Challenges: Science for Technological Innovation, Dr Leonie Jones. (Article and 2m video).
- Piripi Taylor 2019, Urgent action needed to stop further deaths from contaminated water, *Te Ao Māori News*. (Article and 2m video)
- Mānia Clarke-Mamanu, 2018, Waikato river marae to trial first nitrate wireless sensor, *Te Ao Māori News*. (Article and 3m video).

Ngā Kupu

Honohono matū – Chemical bond
Āhua (o te) wai – Water quality
Paerongo – Sensor
Parakino – Pollutant
Pūmanawa whakatauira ahutoru – 3D modelling software
Rangatahi - Youth
Rāpoi ngota – Molecule
Te Tai Tokerau – Northland
Tiakitanga – Guardianship, protection
Tīpako (~na) – Sample, sampling
Whaitua autō – Magnetic field
Whakawhanaungatanga – Process of establishing relationships.

From Paekupu and Te Aka Maori Dictionary