NZASE scientist profile

Bioinformatician Alana Alexander

The University of Otago research team studying the movements and conservation status of parāoa/sperm whales around Aotearoa. From left, Alana, Stella Simpson, Tamlyn Somerford, Dr Will Rayment, and Dr Marta Guerra. Absent: Whitney Steidl. Photo: University of Otago.

Born

Tāmaki Makaurau/Auckland, 1985.

Affiliations

Ngāpuhi: Te Hikutu; Pākehā. Te Hikutu is affiliated with three marae around Whirinaki in Te Tai Tokerau.

Schools and subjects

Long Bay College, Auckland; "I took Te Reo Māori to 4th form; then I had to choose between that and Science, and chose Science." She studied Biology, which she loved, Chemistry, Physics, Statistics and Calculus.

"I was a first generation uni student in our whānau. I only managed to study Te Reo again at Te Wānanga o Aotearoa in 2018, after I got back from doing my PhD in the US."

How she got into science

"I loved the ocean – rock pools, snorkelling, fishing, being out on the water. Nature documentaries were my favourite things on TV. I wanted to be a marine biologist."

Her two summer studentships during her BSc were practical introductions to how science was done. For the first, "I sat in a basement tracing the outline of dolphin dorsal fins, so they could be digitised and matched to photos, to tell us which areas of the Bay of Islands the dolphins were using."

The second was "analysing genetic markers from dolphins of the genus *Sotalia* in the Amazon and around the Atlantic coast of Brazil, to see if they were two separate populations."

"After my science degree, I got a job on a boat and found I got seasick every time I had to write things down, or zoom in with the camera! I realised that with genetics I could learn a lot about whales and dolphins without getting seasick."

Training and jobs

BSc in Biology, 2006; **BSc Honours**, 2007, both at the University of Auckland; **PhD**, on genetic diversity in parāoa/sperm whales, 2014, Oregon State University. **Postdoctoral researcher**, University of Kansas, 2014-17; University of Otago (UoO), 2017-19; **Research fellow**, UoO, 2019-present. Alana also has two certificates and two diplomas in Te Reo Māori from Te Wānanga o Aotearoa, 2020-23.

Fields of science

Molecular ecology, evolutionary biology. Alana describes herself as a bioinformatician, using software tools to understand large and complex genetic data sets.

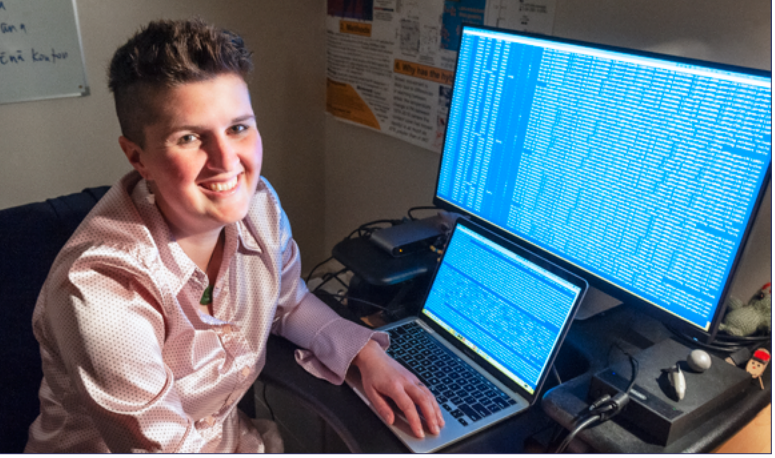
Research topics

Impact of fisheries and toxoplasmosis on dolphins

"We have assembled a genome for a Māui dolphin from the west coast off the North Island, and a Hector's dolphin from the South Island.

"We're now looking at other samples to see how they fit together, how many dolphins there may have been before over-fishing, and how those populations are recovering after fishery exclusion areas were set up."

"We're seeing a lot more dolphins with



Alana with screens of genetic data. Photo: UoO.

symptoms of toxoplasmosis. We're comparing the genomes of those dolphins with others that died from boat impacts, in fishing nets and similar causes, to see if there is any indication of genetic susceptibility to this deadly infection. This may help assess the risks of the disease for different dolphin populations."

Creating 'science pūrākau' using genomic information

"The nerdy, difficult language of genetics makes it hard to understand what results mean," Alana says. "Tūpuna Māori were really good at packing complex ideas about the environment into simple metaphors and stories – pūrākau – that everyone could understand. I'm on a steep learning curve about how the two knowledge systems capture that information in different ways."

As part of her Rutherford Discovery Fellowship, Alana is working with tohunga and kaumātua about their knowledge of whales and dolphins, and discussing new knowledge from genomic analysis.

"We want to work together to translate what we learn from genetics into stories that are as memorable as traditional pūrākau." She will eventually hold a series of wānanga on genomics, supporting communities to build towards their own genetics projects.

Ramari Oliphant Stewart, a tohunga living in Te Tai Poutini, is one of the experts involved. Ramari has helped iwi recover stranded whales and dolphins, and had noticed what she thought were stranded female parāoa in the far south, a long way from their usual habitat in warmer northern waters.

In one of several detours in her research, Alana is extracting DNA from bones that Ramari recovered, to identify the sex of the whales. "It's an example of mātauranga identifying the question, and science in support as a tool," she says.

Parāoa and genetic diversity

Alana's PhD thesis made headlines in 2016. She analysed mitochondrial DNA – passed only through the female line – in more than 1,600 whales around the world, and found they all shared DNA which could be traced back to one female who lived 10,000-80,000 years ago.

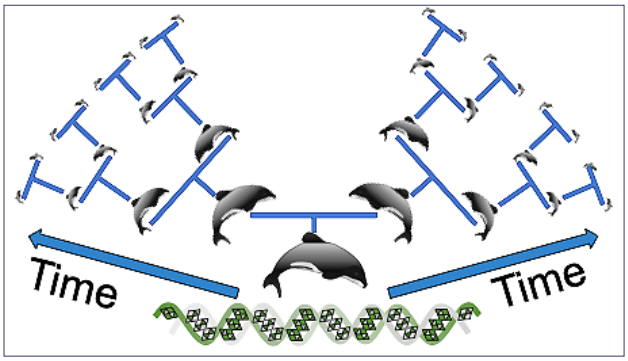
Sperm whales have existed for millions of years, so this result raised many questions. "It was new and surprising," says Alana. "We knew parāoa had low diversity. Although there were likely thousands of other female whales at the time, she happened to be the one who passed down this specific bit of DNA in an unbroken female-to-female line."

Alana is part of a team investigating the genetics of parāoa in Ōtākou/Otago, Kaikōura, and Te Tai Tokerau/Northland, from samples of skin that whales shed as they swim. The team wants to find out where the whales come from and where their whanaunga are in the Pacific.

How she finds things out

Alana uses a mix of genomics, advanced software tools, and ecological data to draw conclusions about events and processes that may have affected populations in the past, or may affect them in the future.

"It often takes only a tiny tissue sample to learn a lot about a species, now and going back tens of thousands of years."



Analysing DNA can be powerful for understanding the past and predicting the future. Image: Alana.

Most valuable result

Alana has collaborated with other scientists about complete parāoa genomes, and found evidence of a bottleneck in the ice ages of the Pleistocene (2.6 million to 11,700 years ago).

"This shows that climate is really impor-

tant to parāoa; with climate getting warmer and weirder, we need to keep a close eye on these whales as oceans heat up." She hopes to create a model that will forecast how global warming will impact parāoa.

Mātauranga Māori

"Mātauranga isn't static; it didn't stop changing and growing when Pākehā came to Aotearoa," Alana says. "It's the ongoing creation of new knowledge."

"Genetic data includes our biological whakapapa, so we're making sure that iwi have a say in how that information is protected. We have a few databases that are stored here, rather than on overseas servers."

"This enables Article 2 of the Treaty to be upheld – Māori having tino rangatiratanga over taonga katoa. Iwi get to decide that people are using genetic data in ways consistent with kaitiakitanga." She gives the example of commercialising a biologically active component in a sponge, which may treat cancer; "is that consistent?"

"One of my other projects, Ruatau, aims to put genomics tools in the hands of Māori communities, enabling communities to identify projects that matter to them. It also aims to strengthen the mātauranga Māori knowledge of geneticists with whakapapa, but little knowledge of te Ao Māori."

What she likes about science

"You get to learn new things about the world, and find things that are new to science, adding to the body of knowledge."

"I also love it when other people's eyes light up because they've learnt something new." Alana starts a lecturer position next year. "It's such a privilege to walk with people as they learn new material."

Links

Alana Alexander, Rutherford Discovery Fellowship. Royal Society Te Apārangi.

Guy Frederick, 2022, Whale watch, *UoO Magazine*, p. 21.

Genomics Aotearoa, Ruatau: Connecting Māori genomics scientists and communities.

Alana Alexander, 2019, A random bioinformatics career walk … and how Genomics Aotearoa is helping researchers be a little less scared of the "command line". *Sciblogs*.

Joshua Rapp Learn, 2016, No, a mitochondrial 'Eve' is not the first female in a species, *Smithsonian Magazine*.

Alana at St Kilda beach, Dunedin. Photo by her husband Ryan Easton.

Ngā Kupu

Ahoaho – Hector's dolphin (one of their names in Te Reo Māori)
Huinga ira – Genome
Ngā ika moana – Whales
Ira – Gene
Mātai iranga – Genetics (study of)
Mātai koiora moana – Marine biology
Rangahau ira – Genetics research
Rangatiratanga – Right to exercise authority
Taonga katoa – All the treasures
Te Tai Tokerau – Northland
Tiakitanga – Guardianship, protection
Tohunga – Expert
Tūpuna – Ancestors
Whanaunga – Relatives.

From Paekupu and Te Aka Maori Dictionary