International interest, as sequencing of the tuatara genome begins

The international biological science community is eagerly awaiting the sequencing of New Zealand’s tuatara – recently identified as one of the most evolutionarily significant animal genomes in the world.

Principal investigator at the Allan Wilson Centre Professor Neil Gemmell attended a meeting of the Genome 10K Consortium, in Santa Cruz last year. The group’s ambitious goal is to sequence 10,000 vertebrate animals within the next five years.

Professor Gemmell says that, because of New Zealand’s unique geographical position in the world, there is always a lot of interest in the country’s species, but particularly the tuatara. “It’s not from the order containing lizards and snakes. It’s a reptilian order all of its own and that’s special.”

Of the 10,000 vertebrates to be sequenced by the consortium, the tuatara was identified as one of the 100 most significant and therefore a priority to sequence.

Professor Gemmell recognised the potential for scientists outside of New Zealand to embark upon sequencing, unaware of the tuatara’s cultural significance. He has, therefore, led efforts to ensure the sequencing process is carried out in partnership with iwi.

Late last year – working alongside Northland-based iwi Ngātiwai, which holds kaitiaki (guardianship) to one of New Zealand’s largest populations of tuatara – Professor Gemmell and fellow scientists were provided with blood samples from a large male tuatara on Māumua Island (Lady Alice Island) of the Hen and Chicken’s group. Sequencing of the tuatara genome commenced in May and is expected to be complete by the end of next year.

“Every single part of this project is epic. For a start, the tuatara genome has at least five billion base pairs of DNA sequence. To put that in context, the human genome has three billion base pairs, so the task is much greater – just in terms of volume of raw information. However, genome sequencing assembly becomes exponentially harder the larger the genome. The tuatara genome will be one of the biggest genomes ever assembled, making it a challenging project. The project is growing in momentum, with support from both New Zealand and international scientists. It’s an exciting project to be a part of.”

The advanced genomic technologies required to physically carry out the sequencing work have only recently become available in New Zealand, through New Zealand Genomics Limited (NZGL) – a government-funded collaborative infrastructure for New Zealand science.

Professor Gemmell says that sequencing the tuatara genome within New Zealand would not have been possible without NZGL and its recently-purchased Illumina technology. “But there’s another element to this. During this project, we may develop new approaches around sequencing methodology and it is not inconceivable that New Zealand scientists may attract attention for their expertise in the complex field of genomics technology. Certainly, we already punch well above our weight in this field, with our prowess well established through our agricultural, horticultural and forestry endeavours. Here, we have the opportunity to make a contribution to our understanding of life on earth through the sequencing of an organism unique to New Zealand, which is not only a taonga (treasure) to Māori, but to the world – due to its critical importance to our understanding of the evolution of many vertebrate lineages, including ourselves.

“To sequence the tuatara genome is something very prestigious. It’s scientifically important, but will also have practical benefit for the conservation of this special species. Crucially, it will help us better understand tuatara and their ability to respond to future changes in its environment, particularly climate. Because they have temperature-dependent sex determination during egg incubation, we do wonder about the impact of global warming and what that might mean for the sex ratio of this species. On the disease front, tuatara appear not to suffer from too many ailments – they’re pretty tough – and we want to know more about that natural immunity.

“A full genome will also help us develop genetic tools to better understand the relationships between different tuatara populations around New Zealand – how different populations link and how long they’ve been isolated from each other.”

As the project builds, there will also be increasing numbers of training opportunities, mostly for PhD and postdoctoral researchers, Professor Gemmell says. “We hope to use this project as a broader educational platform through which multiple groups from a diversity of backgrounds can benefit, including the people of Ngatiwai.”
Ngatiwai Trust resource management coordinator Clive Stone says the trust’s board is pleased to be working with Professor Gemmell and NZGL to support the sequencing of the tuatara genome.

“Ngatiwai are aware of the potential that sequencing the tuatara genome holds for our young people, including the opportunities it could present them through participation in the research. It is also increasing our understanding of these very special taonga.

“This project provides the Ngatiwai Trust Board with the opportunity to exercise kaitiakitanga (guardianship), by having an active partnership role in the decision making process, as well as participating in the management and monitoring programmes.”

The Department of Conservation is also in support of the project, recognising the vulnerability of tuatara to extinction and the potential insights a full genome sequence will provide in aiding conservation efforts.

The project includes researchers from the Allan Wilson Centre for Molecular Ecology and Evolution and University of Otago. It is funded by the Allan Wilson Centre and has support from the University of Otago Centre for Reproduction and Genomics, New Zealand Genomics Ltd and Illumina Asia Pacific.

“tuatara” image caption: Tiare Apatera Wills (18) is part of a kaitiaki group of rangatahi (young people), who volunteered to be a part of a Ngatiwai environmental project. The day this image was taken, the group was carrying out recapture surveys to estimate the population sex ratio and the health of tuatara – to compare to other islands’ populations and against survey data from 1989.