A barcode for every plant in Kruger?

By Melissa Wray
In Kruger National Park

Science fiction is rapidly meeting science fact in the world of genetic research, and a team of scientists working in the Kruger National Park (KNP) are taking early steps in a process that will someday allow a person to take the tiniest scrap of a plant's leaf, drop it into a handheld machine and minutes later accurately identify what species of plant the leaf came from. No more scrutinising a plant in minute detail, wishing for flowers to emerge to help with identification, or confusion between two closely related species.

The reality of this is closer than one might think. Already scientists have developed a 'DNA barcoding' process for animal species, which allows a tiny scrap of animal skin or blood or any other suitable tissue to be put through a DNA sequencing machine and within a short time reveal whether it was a bird, bat, human, cow, polar bear or any other animal species that provided the tissue sample.

The race is now on to develop a similar DNA barcode for all plant life – an ambitious task when you consider that there are some 300,000 different plant species on earth. Kruger is playing an important role in this race and is already a forerunner in that over the last several months more than 1,600 different specimens (around 600 different species) of plants in the park have donated a few leaves to science. This represents the largest and most diverse sampling ever made for DNA barcoding purposes in a protected area anywhere in the world.

Under the supervision of Dr Michelle van der Bank from the University of Johannesburg and Dr Vincent Savolainen from the Royal Botanic Gardens at Kew in the United Kingdom, three postgraduate students have been conducting a complete inventory of Kruger's plant life.

Out in the field, Olivier Maurin, Renaud Lahaye and Sylvia Duthoit have been diligently collecting plants according to a pre-determined sampling programme. They collect two types of specimens. Firstly, they collect approximately 30cm long branches/stems with leaves (and flowers and fruit if possible), which are dried out in plant presses or preserved some other way to act as herbarium specimens, in much the same way as early explorers collected the plant life outside of their home countries. The second specimens that the barcoding team collects are fresh leaves, which are placed in a special silica gel which rapidly dries them out without harming the all-important DNA inside.

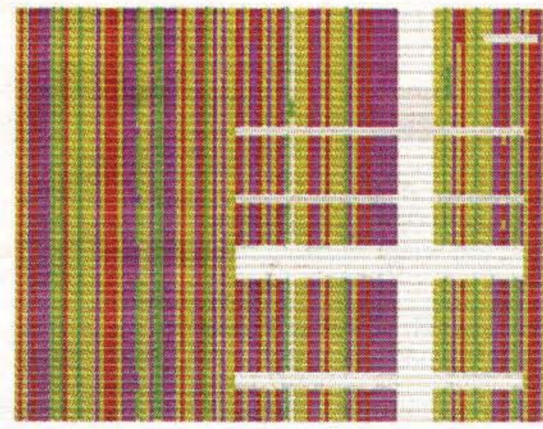
The samples are then taken back to the lab, with herbarium specimens being collected for Skukuza's herbarium as well as for Kew's herbarium. The leaves that have been dried in the silica gel are then treated and put into a machine that will sequence the DNA inside the leaf's cells. Only a tiny amount - 0.3g - of leaf material is needed to provide enough raw material for the genetic sequencing machine to work on.

The scientists are not trying to look at every single last scrap of DNA in each leaf. Rather they are looking for one or two genes that are found in all different kinds of plant life, but have a specific makeup that differs from species to species. By knowing how the exact composition of these genes is different between the species, the scientists can then create a barcode that will allow for rapid identification of different species from samples of unknown origin. And this is where Kruger's rich plant life comes into play – within one national park, researchers have access to a rich variety of raw material to find out which gene is the best one to develop the barcode of plant life. Competition is stiff – there are scientists from 11 different institutions worldwide who are all in a race to be the first to produce a green barcode.

Although it's unlikely that a handheld DNA scanner will be on the market anytime in the next few years to help people walking in the bush to settle disputes as to exactly which particular species of grass they are walking on or which exact tree an elephant has just snacked on, DNA barcoding has other uses. In the search for suitable genes, scientists can also use the genetic material to find out which species are most closely related, and which species that look superficially alike are actually different and therefore in need of conservation.

The technology also has implications for fighting eco-crimes – already barcoding can reveal if a hacked-up piece of bushmeat being sold in an open-air market is from an endangered species or is actually a bit of goat meat in disguise. By barcoding plants, illegal trade in cycads could be more closely monitored by officials with no botanical knowledge, along with other applications. And with bio-piracy on the increase around the world, conservationists need as many tools as they can get.

While the computers and DNA sequencers crunch their way through the 1,600 specimens collected in Kruger and anticipate the next batch of samples to be collected next year as the project continues, taxonomists and botanists are looking at all the herbarium specimens collected in the old-fashioned plant presses. Using good old-fashioned experience they are identifying all the individual species so that when the high technology spits out a gene sequence, they know exactly who it belongs to. After a hard day of eyestrain in the classification process, they are probably not sure whether to wish for the day that science fiction becomes science fact – because then their years of experience may be replaced by a little black box that anyone can operate.



Far above: A matrix of DNA sequences produced by the DNA sequencing machine. Each colour represents one of the four base compounds that make up DNA – adenine (A), guanine (G), cytosine (C) , thymine (T). It is the specific order in which these four compounds are repeated that makes every living organism unique. The compounds pair up to link DNA strands together, and there are about three billion base pairs in one set of human DNA.
a

Below: Renaud Lahaye in the molecular laboratory where the DNA is sequenced

Left: Trails ranger Robby Bryden looks on while Olivier Maurin and Herman van der Bank prepare herbarium specimens for placement in the plant press.