DNA profiling for trees will, one day, be used to curb illegal logging.

BY NATALIE HENG

Deoxyribonucleic acid, otherwise known as DNA, is nature's barcode. It is inherent in nearly every cell in every organism, and could just be our answer to curbing illegal timber trade.

It might sound like science fiction or something out of an alternative CSI episode where investigators track down trees instead of killers, but DNA fingerprinting for trees based on technologies routinely used in criminal forensics holds much promise in the field of international enforcement.

In fact, these tools are prime candidates for putting a spanner on illegal logging – an industry which has devastating consequences for biodiversity, ecosystems and local economies alike.

To understand how this is possible, you need to think of DNA as a code. Genes in specific sequences translate into a variety of proteins which do most of the work in cells (structure, function, and regulation of the body’s tissues and organs, for example).

A good analogy put forward by evolutionary biologist Richard Dawkins is to think of genes as instructions in a cooking recipe. The instructions “collaborate” in the cookbook process to culminate in a dish.

Genes are expressed in a similar fashion, but result in development processes which culminate in a body, be it human, fly or tree.

Dr Lee Soon Leong specialises in planting the DNA found in trees. He wades through peat swamps and treks through isolated forests to expand his collection of tree DNA samples, which he studies at the genetics laboratory at Forestry Research Institute Malaysia (FRIM).

In this leafy hub of scientific activity hidden away from the dusty streets of Kepong, Kuala Lumpur, Lee hones the genetics laboratory. In recent years, his team has been engaged in research which has important implications for prosecutors trying to bring illegally logged timber cases to court.

To understand this work, however, we first need to understand a highly interesting and useful feature of DNA – some sequences are highly conservative, whilst others are more variable.

Chloroplast genes which code for proteins involved in photosynthesis, for example, perform an important function that green plants cannot do without – allowing green plants to use energy from sunlight to synthesise food out of carbon dioxide and water. The DNA in these gene sequences are therefore highly conservative, and are likely to be very consistent between individuals of the same plant species.

Not all DNA sequences actually code for genes, however, and within these intergenic regions, harmless mutations which do not pose any disadvantage will often occur, and be passed on to subsequent generations. In this way, sequence changes can clock up along these segments, so the DNA profiles of specific intergenic regions in a distantly related group of trees will be increasingly more divergent from those of their founding population. This feature makes DNA profiling the perfect tool for shedding light on the murky routes of illegal timber trade, which is often obscured by log laundering.

Doddgy paperwork is just one of the methods companies use to disguise the origin and species of timber, effectively “legalising” logs that have come from an illegal source.

When you consider how advanced the world has become – increasingly powerful and advanced technologies being made to members of the public through smartphones, for example – it is surprising just how rudimentary our global timber trade tracking system is.

The main checks that occur rely on an examination of externally applied, and easily manipulated, marks such as ink, metal bands and tags. These are cross-checked against paper documents, which can be falsified.

It is hard to blame customs officials. After all, a block of wood is, to the average person, a block of wood. Shipments of processed logs all pretty much look the same when you’re not trained in wood anatomy, which is currently the standard method used in log identification.

Even then, a timber package suspicious enough to warrant checking is subject to some disadvantages – important timber tree species are not necessarily visually distinguishable from similar species in the sawn form. All these are serious problems when it comes to the mislabelling of trade-restricted or endangered species of wood for laundering purposes.

The barcode of life

Illegal loggers might be able to mess with the paper system but they cannot mess with DNA. It is a unique property inherent in trees, and present in almost every cell within a solid wood product. It is the differences in variability across the genome that has allowed scientists like Lee to play detective, taking unknown wood samples, and tracing their origins using specific DNA sequences or “DNA markers”. Highly conservative DNA markers that are consistent within a species can be used as “barcodes” for species identification, he explains.

Since their project began in 2010, Lee’s team has amassed barcodes for half of Malaysia’s 408 commercially valuable timber species. The database of barcodes can be used for rapid identification of wood species used in heavy construction and furniture manufacturing. There is also potential implication in conservation as the barcodes can be used to assess plant biodiversity.

Whilst the highly conservative barcodes can be used for timber species identification, intergenic markers can be used to track geographical origins. Closely related trees located within the same timber concession might share common marker sequences, but the furr-
Barcode for trees

The lack of practicable control mechanisms to identify the origins of timber and wood products means that every year, an undetermined amount of illegally logged timber makes its way to the mainstream market. In 2010, 6% of the wood exported from South East Asia, the Amazon, central Africa and Vietnam is suspected to have come from illegal sources, according to the European Union’s Forest Law Enforcement, Governance and Trade Action Plan. This is equivalent to US$1.5 billion worth of losses in revenue and assets every year for some of the poorest countries in the world.

It is acknowledged that illegal deforestation is a responsibility of suppliers, but also consumer countries. Next year, a new piece of legislation will come into force, effectively banning the world’s largest single consumer of timber from importing and purchasing from any illegal timber traders. Being able to make geographical distinctions with regard to the place of origin of the timber has ground-breaking implications. It means that a DNA sample extracted from any piece of wood, be it a shipment going through customs or a piece of furniture, can be used to cross-check the source that is stated in the paperwork.

Proving that mislabelled logs have not originated from a legal timber concession remains one of the timber world’s biggest challenges.

Section 15 of the National Forestry Act 1984 prohibits the taking of forest produce from permanent reserved forest or state land forest without a licence but it has yet to be the basis for any prosecution, partly due to the difficulties involved in producing evidence strong enough to stand up in court.

Lee says the primary application for his research is to furnish enforcement agencies with the necessary tools to do their job. Microsatellite markers, for example, should be good enough

The ultimate goal is to eliminate the possibility of falsifying accompanying chain-of-custody documents, by introducing a new and effective weapon in the fight against timber laundering. Aside from recent DNA database profiling work done at the Forest Research Institute of Malaysia, there are a number of international projects geared towards similar objectives.

There is also potential for co-operation with existing databases, such as the Barcode of Life, which is an international collaboration of scientists to create a single, open-access database containing barcodes for as many species as possible.

Due diligence through DNA

a technology with similar uses, are emerging to take centrestage, as they might just be the solutions the world is looking for when it comes to the due diligence required for the issuance of FLEGT timber export licences.

In line with this, Biodiversity International has launched a new facility, based in Kuala Lumpur, to promote the identification of timber species and their origins. Scientific co-ordinator for the facility, Marion Else, says that by the end of the three-year project, they aim to have a functional international database featuring genetic and stable isotopes for 20 major continental species of timber.

“Also we expect to have an international agreement on standards for using genetic and stable isotopes markers for timber species identification and tracking, so certification bodies and other service providers can start incorporating genetic and stable isotopes fingerprinting into their evaluation criteria,” says Else.

As the advantage of DNA and stable isotopes is that they can be used with processed wood. ‘Such tools are already being used for major food commodities. There is no reason why it should not work for wood and wood products.’

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Due diligence through DNA

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> Raw material testing – This can be done at checkpoints along product supply chains.
> Wood product quality control
> Sampling and factory inspections – Checks can be made during the manufacturing process, especially for risk species in regions where fraud is prevalent, or management processes are weak.
> Chain of custody – This is a key to maintaining the integrity of the timber.
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Applications of a tree DNA database

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It might be a while before the science is translated into a viable system offering wood-based timber tracking services but at least the wheels have been set in motion, promising a better chance at curtailing the global illegal timber trade. – By Natalie Heng