A genetic barcode against forestry law-breaking

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A local resident shows the much sought-after red heartwood of a rosewood species. (Photo: Zurich Zoo, Martin Bauert)

The massive overexploitation of Madagascar's tropical woods is endangering the island's unique flora and fauna. A project by ETH Zurich and Zurich Zoo aims to make the illegal wood trade more difficult through a new declaration method for wood.

The filmmakers of the Dreamworks Animation Studios conquered the hearts of an audience of millions with their animation films "Madagascar 1 and 2". The neurotic zoo animals were not the only ones that became the public's darlings, so did the lemurs, who play a central role in the films.

However, the reality is anything but a dream. It's a nightmare for

Madagascar's unique flora and fauna. Illegal logging is threatening the last of the island's forests, the habitat for around 100 different lemur species. The loggers are eager to get their hands on exotic woods such as rosewood or ebony. And they don't stop even at the boundaries of national parks like the Masoala National Park. 100 to 200 trunks were felled and stolen from the National Park every day in 2009.

The crisis is fuelling the race for wood

90 per cent of Malagasy wood is shipped to Asia to manufacture expensive furniture, and 5 per cent to Europe and the USA, where the guitar industry in particular creates a large demand for tropical woods. The illegal wood trade is flourishing, with a turnover of hundreds of millions - annually. The thickest trunks have now been felled and the illegal loggers are felling ever thinner trees. The situation was exacerbated by political unrest that shook Madagascar in March 2009. It resulted in a freeze on international aid funding, which speeded up the run on natural resources.

In response to international pressure, the island's government has now agreed to have the threatened exotic woods put on the CITES protected species list. The aim of the CITES convention is to ensure that international trade in plants and animals is permissible only with proof of origin – or not at all if a species is listed in Annexe 1.

However, providing this proof of the species from which the wood originates is difficult for tropical trees. There are around 60 species of Dalbergia on Madagascar, eight of which belong to the coveted "rosewood" species. The heartwood of these trees is red and hard, and therefore much sought after. The remainder, the softer pale cambium (sapwood), is hacked away as useless deadweight. Distinguishing between rosewood species without any leaves, fruit or flowers is impossible.

Genetic barcodes

Professor Alex Widmer of the Institute for Integrative Biology at ETH Zurich and Martin Bauert from Zurich Zoo have now started a project to enable proof of species to be provided despite these difficulties. The idea: to develop a method allowing the genetic material to be isolated from heartwood, to analyse it and to set up genetic 'barcodes" for each species. This would enable samples of suspect wood to be taken anywhere in the world, and its origin and identity determined genetically. "This is a method to verify the declaration. It can be used in future to detect illegally felled wood and to confiscate it." The ETH Zurich professor hopes this will enable the buyers of the wood to be held liable, which should reduce the demand and thus stem the overexploitation.

There are a few obstacles to be overcome to make this a success: Widmer's doctoral student Sonja Hassold, who is carrying out the project as the recipient of a doctoral grant from the Zurich-Basel Plant Science Center with support from the Swiss Mercator Foundation, stresses that "isolating DNA from wood is difficult." This is because there is scarcely any living material containing DNA in heartwood. Moreover, the genetic material degrades after a tree is felled, partly breaking down into short fragments that are hard to analyse. This degradation also depends on how long and under what conditions the wood was stored.

Genetic distinction between species is difficult

It is also unclear whether there are only eight species. Widmer expects that his doctoral student will find material from previously unknown species during her research trip to Madagascar. So the barcode strategy would also need the ability to recognise and determine unknown species – a problem that science has not solved.

Another difficulty: tropical species are often closely interrelated, so the genetic differences are small, especially in the chloroplast DNA that the biologists use for barcoding. Thus Hassold was only able to distinguish three groups with the first tests she carried out on reference material from Madagascar and the Zurich Zoo. The chloroplast DNA of the rosewood species is insufficient to determine the trees at the species level.

The researchers must therefore also study the genome of the cell nucleus and find new genetic markers, such as microsatellites. However, the genetic material from the cell nuclei of the tree species in question is largely unresearched. Widmer says, “That’s why we must use state-of-the-art sequencing methods to develop these markers as quickly as possible.”

Herbaria are important

Identifying the trees is made more difficult by a problem that Hassold only encountered on her collection visit to Madagascar: most of the big trees have already been cleared away. Most of those that can still be found are young plants without the characteristic features of a “mature” tree – flowers, fruits, bark or distinct leaf shapes. This means she lacks comparison material for DNA tests, which makes it difficult to assign a barcode to the corresponding tree species. Thus comparison material from herbaria and scientific collections with dried specimens will play an important part.

The study could be extended to other tree species in the future, because other species are now being grabbed increasingly as substitutes for the rosewoods, e.g. trees in the Diospyros genus. And the researchers know even far less about these. Nonetheless the ETH Zurich Professor is confident that they will succeed in identifying the trees on the basis of their DNA, thus making a contribution to preserving the habitat of the likeable animation film heroes and their living models.

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