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Conference Abstract

Ebony Wood Identification to Battle Illegal Trade

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Abstract

Illegal logging is a serious global issue. It is not only a great threat to rare forest species, but also contributes to the current biodiversity crisis and climate change. Despite international agreements, 10-30% of all imported wood has been illegally logged. Many of these trees, especially rosewood (*Dalbergia*) and ebony (*Diospyros*), are very important for the global market because of their high economic value. Ebony is a common name for the black heartwood (inner parts of the stem) of some *Diospyros* species. These woods are used in products such as acoustic musical instruments. The genus *Diospyros* includes over 700 species globally. More than 200 of them are endemic to Madagascar, which is a one of the richest regions in terms of biodiversity. This island is situated in the Indian Ocean off the coast of Eastern Africa and is known for its unique biodiversity.

Due to over-harvesting in recent decades, many Malagasy species of *Diospyros* are listed as endangered under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES; CITES checklist for *Diospyros*). Trade of these species requires CITES permits. All described Malagasy ebony species under Appendix II meaning that, while not currently threatened with extinction they may become so if trade is not controlled. Controlling the logging trade is often more difficult than it seems. Labels are easily switched, different species of wood can be mixed, permits can be falsified, and many more tricks are used to get illegally logged wood onto the global market.

One of the most commonly used techniques to identify timber products is the assessment of species-specific cellular patterns (White et al. 1991). Wood anatomy has been practiced

for more than 200 years, and automated tools have been developed to identify wood at the genus and species level over the past decade (Figueroa-Mata et al. 2018, Hafemann et al. 2014, Koch et al. 2011, Ravindran et al. 2018). However, the lack of sufficient resolution for species-level identification, especially for speciose genera such as *Diospyros,* is the main drawback of this method. Identification using molecular barcoding is an alternative but challenging method as timber is composed mainly of dead cells and the few living cells often have poor DNA quality. A third identification method is direct analysis in real time time-of-flight mass spectrometry (DART TOF MS; Espinoza et al. 2015, Evans et al. 2017). This method analyses the chemical composition of a wood sample, resulting in a species-specific chemical fingerprint. DART TOF MS has already been successfully applied to several tree genera including *Dalbergia* (rosewood), *Aquilaria* (agarwood), and *Quercus* (oak). The main disadvantage of this method is that it can only be applied to heartwood samples from the inner part of the trunk.

In order to develop a comprehensive and accurate identification tool to identify Malagasy ebony woods, we are working towards building an image recognition model based on wood anatomical microscopic images. As a case study, we successfully trained our classifier using a public dataset (Martins et al. 2012) such that our model was able to distinguish different tree genera of that dataset with 93% accuracy. We are currently extending this work to the subgeneric level of *Diospyros*. This will be used to establish the presence of ebony woods in acoustic musical instruments based on reference samples from wood specimens preserved in natural history musea. To achieve sufficient accuracy, we are focusing on the microscopic features of transverse and tangential orientation planes in ebony woods. Our database will include very high resolution images of *Diospyros* species, and can help wood anatomist at wood identification institute and customs officers at harbours to increase the accuracy of the identification of illegally logged ebony woods.

Keywords

Malagasy *Diospyros*, convolutional neural network, ebony wood identification, illegal logging

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