Research in Progress
Forest Products Laboratory

Anatomically Informed Optimization of DNA Extraction from Wood and Wood Products for Forensic Analysis

Combating illegal logging requires, among many other things, robust laboratory methods for the identification of wood species, origin, and even individual tree or board matching. One of the most promising approaches to meet these needs is the application of DNA-based methods. Scientists around the world are developing powerful sequence databases, extracting DNA from leaves and other DNA-rich plant parts. These databases could revolutionize global capacity to use DNA to identify wood and wood products. The choke-point in the broad utilization is the extraction of sufficient quantity and quality DNA from a wood or wood product, especially in a cost-effective manner in normal molecular biology laboratories.

A hickory specimen showing the heartwood–sapwood transition and inner and outer bark. DNA content is highest in the inner bark and lowest in the outer bark and heartwood. Inset: a fluorescence micrograph of freezer-milled Alaska yellow-cedar showing intact nuclei (blue-white dots). With organellar microcapture, we will be able to selectively extract the nuclei for analysis.

Background

Compared with many other plant parts, wood is a comparatively poor source of DNA, even in the living tree. Processing of wood into wood products (sawing, drying, and finishing) often further reduces the presence or extractability of useful DNA in wood. DNA identification of wood species, origin, and/or individual boards is highly desirable and theoretically possible, but in practice is limited by the quantity and quality of DNA in extractable form from wood and wood products by traditional methods. To empower the widespread use of DNA approaches in timber forensics, we must develop methods that maximize the quantity and quality of DNA from wood and wood products and provide tools to predict optimal preprocessing steps and extraction chemistries.

Objective

The principal objectives of this project are to (1) identify the best sets of preprocessing steps and extraction chemistries to maximize DNA yield from wood and wood products, both in terms of DNA quantity and quality, and (2) develop a data set that permits predictive assignment of an untested wood to a given extraction protocol based on the wood anatomy of the new wood.

Approach

We will assess 12 wood species (mostly North American) representing the end-points of variability in a wood structure continuum matrix to determine best practices for preprocessing wood for DNA extraction and evaluate these preprocessing steps in the context of various extraction chemistries. Further, we will develop a custom technique to extract single organelles for DNA extraction (organellar microcapture) and use this technique to establish DNA quality positive controls and explore its application to trace forensic evidence.

Expected Outcomes

We expect to develop advanced protocols for DNA extraction that provide better quality and/or quantity DNA than current methods, empower the use of widely available DNA databases, and predict optimal extraction protocols for new woods based on wood structure.

Timeline

The project will begin in May 2016 and be completed by September 2018.

Cooperators

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