

Building a DNA barcode library for the Canadian flora using herbarium collections

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The dry, mothball-scented stacks of a herbarium might seem to be far away from the cutting edge of plant science. However, the curated plant specimens stored there contain irreplaceable genetic, morphological, ecological, and chemical information just waiting to be analyzed with modern techniques. In a new study in a recent issue of *Applications in Plant Sciences*, Dr. Maria Kuzmina at the University of Guelph and colleagues tapped this trove of information, showing that herbarium specimens can yield viable DNA barcode libraries.

A DNA [barcode](#) library is a kind of molecular identification key that compiles DNA sequence (the "barcode") from each species in the library, focusing on a few well-studied, easily sequenced genomic regions. This allows future researchers to sample the DNA from an unknown species, sequence these regions, and easily find which species the sample came from by comparing the sequence to the library.

"These references are used for forensic identification of samples with a single DNA source, including direct identification of the plants if morphological characters are unavailable," said Dr. Kuzmina. They are also "in great demand in metagenomic projects for both practical and theoretical questions, like analyzing plant supplements and food, or environmental DNA in soil and water."

Other studies, including those by Dr. Kuzmina, have previously demonstrated that [herbarium](#) specimens can produce DNA barcode libraries. This study stands apart in its scale, providing barcodes for 98%

of the vascular plant species in Canada (5,076 of the 5,190). In total, the authors examined 13,170 individual specimens from 27 herbaria across Canada and the northern United States, supplemented by 7,660 freshly collected specimens. The scale of sampling makes the resulting DNA barcode library more powerful for species identification, because query sequences are less likely to match an incorrect, closely related reference species if the correct species is also present in the library.

To assist future researchers in making use of herbarium resources, the authors also quantified the factors that influence DNA degradation in [herbarium specimens](#). Unsurprisingly, the authors found that factors such as age and method of preservation affected the level of DNA degradation. They also found that the family to which the [species](#) belongs matters, because compounds present in some families but not others could affect DNA degradation.

"Our analysis is based on a large sample, which was parsed not only by age, but also by taxonomic affiliation, and we found that some groups of [plants](#) are capable of preserving DNA for a really long time," said Dr. Kuzmina. "The oldest specimen we succeeded to recover the DNA barcodes for our collection was collected in 1849. It belonged to lady's mantle (*Alchemilla*) from the rose family."

As Dr. Kuzmina and colleagues demonstrated, the genetic information stored in herbaria is an important resource for the 21st century. "In the herbarium you find specimens carefully collected, identified, and catalogued by several generations of professional field botanists, across the entire country, during all vegetative seasons, including distant areas, and rare findings," said Dr. Kuzmina.

The high-quality curation and identification of each reference specimen by experts, and the traceability of each reference sequence back to a physical specimen lends the barcode library a level of taxonomic

authority that only a herbarium can. "Annotated by experts, this material provides unparalleled source of references for those who perform molecular studies," said Dr. Kuzmina. "Without the fundamental knowledge about biodiversity the cutting edge sciences cannot operate."

More information: Maria L. Kuzmina et al, Using Herbarium-Derived DNAs to Assemble a Large-Scale DNA Barcode Library for the Vascular Plants of Canada, *Applications in Plant Sciences* (2017). [DOI: 10.3732/apps.1700079](https://doi.org/10.3732/apps.1700079)

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