# Barcode of Life – the British Flora

**Background information:**

All over the world scientists are working to establish genetic identification systems for life on earth and they endeavour to make this information freely available to all potential users via the Internet. Such initiatives are often referred to as DNA barcoding. DNA barcoding is the use of a short DNA sequence or sequences from a standardised locus (or loci) as a species identification tool. For plants there are many potential uses for such a tool, for example:

- Identification of different life stages, e.g. seeds and seedlings
- Identification of fragments of plant material
- Forensics
- Verification of herbal medicines/foodstuffs
- Biosecurity and trade in controlled species
- Inventory and ecological surveys
- Scientific research

**Why Barcoding?**

Climate change and increasingly dramatic shifts in land use threaten to exacerbate the existing biodiversity crisis. Meeting the imperative of environmental stewardship requires support for the scientific endeavours of documenting, predicting and managing ecological change on a global scale. This will require not only a one-off description of organismal diversity (a formidable challenge in itself), but also the ability to monitor biological communities year after year. A prerequisite for conserving biodiversity is the identification of organisms in the field. Today, this task is carried out mainly by taxonomists applying their specialist skills because the vast majority of other players in the field of conservation and sustainable development are unable to identify any but the most familiar species.

The Convention on Biological Diversity affirms that this so-called "taxonomic impediment" poses a serious threat to conservation and management of biological diversity. The urgent need for a rapid, accurate, and web-accessible taxonomic resource will require the full utilisation of information technology and molecular biology (UK Government, 2004; EPBRS, 2004). Fortunately, a DNA-based identification system, operable by non-specialists, to complement parallel developments in taxonomic informatics is within reach. "DNA barcoding"[3] (www.barcodinglife.org) involves sequencing a short stretch of DNA that, while universally present in all species, ideally exhibits robust species-specific sequence variation. DNA barcoding has the potential to deliver a universal toolkit and web-accessible framework for the rapid application of molecular diagnostics to global biodiversity.

DNA barcoding has already proved useful for identification (and in some cases delimitation) of animal species, but plants (in a broad sense, including land plants, algae and lichens) are only beginning to attract the attention of the DNA barcoding community. Before a DNA-based plant identification tool can be realised, however, several important scientific and methodological questions must first be addressed. The preferred gene for animal barcoding, *cytochrome oxidase 1* (*CO1* or *cox1*), is not suitable for plant barcoding because low rates of substitution in this gene have caused a lack of sequence variation among plant species. Plants also pose unique challenges to barcoding: prevalent hybridisation, polyploidy and apomixis may undermine the utility of even an ideal barcode locus. Thus a prerequisite to a universal plant barcoding procedure is a period of rigorous experimentation to determine how–indeed, if–DNA barcoding at a floristic scale can succeed.

**Why Barcode the British Flora?**

The best-documented flora on earth, the British flora presents an ideal opportunity to test the feasibility of barcoding in plants and the challenges of geographically defined plant barcoding initiatives. DNA barcoding of the British flora involves three distinct phases. ***Phase I*** is the identification of suitable barcoding loci for each group. An international project (involving all three institutions in this proposal) to identify a universal land plant barcode locus is now entering its final stages and similar initiatives are screening loci in macroalgae. In lichens and diatoms, appropriate loci still need to be developed. ***Phase II*** will utilise a large-scale pilot study to address the scientific

challenges of plant barcoding. This phase will inform next-generation plant barcoding projects worldwide, including more complex and species rich floras where taxonomic information—and the ability to apply it—is urgently required. ***Phase III*** will expand the pilot study into a comprehensive database and identification resource. **We are actively seeking funds to complete Phase I for lichens and diatoms and to undertake rigorous Phase II testing to address the scientific challenges of plant barcoding.**

We anticipate that DNA barcoding will one day become both a practical solution to the "taxonomic impediment" and a routine curatorial procedure. DNA sequences will annotate voucher specimen data, increasing the utility of taxonomic information to a wide range of end users including but not limited to biological research. However, barcoding today, especially in plants, is still firmly within the realm of scientific research since the questions that must be answered to create such a tool are largely hypothesis driven. Can molecular sequences characterize a species? Can DNA barcodes characterize a flora by identifying its elements? If so, are they successful across all plant groups? To what extent does barcode data corroborate and complement the established taxonomic structure? What fraction of plant biodiversity is comprised of cryptic species and is as-yet unnamed? Broad and deep molecular sampling of a well-documented flora is required to address these key questions, and the answers will determine the future of molecular identification for plants.

The Consortium for the Barcode of Life (CBOL) is an international initiative devoted to developing DNA barcoding as a global standard in taxonomy. CBOL has more than 100 Member Organizations from 40 countries including:

> Natural History Museums
> Zoos
> Herbaria
> Botanical Gardens
> University Departments
> Biodiversity Organizations
> Governmental and Intergovernmental Organizations
> NGOs
> Private Biotech Companies
> Other Research Organizations