

# THE CANADIAN BARCODE OF LIFE NETWORK

## SUMMARY

DNA barcoding is a highly promising approach to resolve the ‘taxonomic impediment’ that constrains much biodiversity research. While the ultimate objective is to barcode all species, our Network seeks to assemble barcodes for the genetic identification of economically, socially, and environmentally important organisms from the Canadian biota. In addition to the pursuit of a national biodiversity research agenda, our researchers are playing lead roles in a number of international barcoding campaigns, including the Fish Barcode of Life Initiative (FISH-BOL), and the All Birds Barcoding Initiative (ABBI). Barcode of Life Data Systems (BOLD) developed by our Network is also playing an important role as a barcode repository and workbench for the international barcode community.

## INTRODUCTION

The Canadian Barcode of Life Network, and the large international consortium of which it is a part, seeks to develop an accurate, rapid, cost-effective and universally accessible DNA-based system for species identification. Our Network represents the first of its kind, an enterprise dedicated to barcoding all biodiversity within a nation’s boundaries. It involves researchers and funding support from a broad range of institutions across Canada.

Barcoding, at least for the animal kingdom, involves generating a comprehensive reference library of short (648 base pair) mitochondrial DNA sequences derived from expert-identified voucher specimens. The primary goal of the Canadian network is to continue work on the assembly of barcode records for animals while extending the DNA barcode paradigm to the remainder of eukaryotic life, including protists, plants and fungi. For animals, about 100K species will need to be barcoded to complete the national survey. At least 10K of these species will be barcoded within the next 5 years. Among protists, research will target macroalgae, microalgae, and ciliates, with emphasis on their possible roles as bio-indicators of ecosystem health. Barcoding of the approximately 5,600 species of plants present in Canada will proceed with emphasis on optimizing protocols for identifying roots, pollen, seeds and spores. Fungal research will proceed with initial emphasis on barcoding known pathogens.

The logistical challenges of barcoding biodiversity at this scale are considerable, and a robust strategy is required to coordinate the flow and processing of both specimens and resultant data. Key areas requiring attention include laboratory processing, information management, and the coordination of the efforts of all stakeholders. In this regard, the Canadian Barcode of Life Network has led the development of protocols for large-scale DNA barcoding. The further refinement of laboratory protocols occupies a central role in the whole barcoding process, and remains a primary focus of the Analytical Platforms Theme in our Network. The core analytical facility for the Canadian Barcode of Life Network has pioneered the optimization of laboratory techniques for high-throughput DNA barcoding.

The geographic dispersion of our Network’s participants stands in contrast to the strong *virtual* cohesion of our research. This unity is achieved through a web-based analytical platform known as Barcode of Life Data Systems (BOLD), which presents varied collaborative tools for data management, from specimen collection records and taxonomy to the DNA barcodes themselves. This critical data management and analysis system is the backbone of our operations and it has now been adopted by two global barcoding campaigns (involving fishes and birds). It represents the most significant contribution from the Canadian Barcode of Life Network since the advent of DNA barcoding itself.

The Network includes the following research themes and principal investigators:

<b><u>Taxa</u></b>	<b><u>Investigators</u></b>
Agricultural and Forestry Pests	- Hebert*, Humble, Johnson, Landry
Biological Invaders	
- Inland Waters	- MacIsaac, Heath
- Forestry	- Humble
Biting Insects	- Currie, Hunter
Freshwater Resources	- Bernatchez
Marine Resources	
- Atlantic	- Bentzen, Dufresne, Kenchington
- Pacific	- Boutillier, Hebert
Parasites	
- Molecular Divergence	- Brooks
- Fishes	- Marcogliese
Pollinators	- Kevan, Packer
Terrestrial Vertebrates	
- Amphibians/Reptiles	- Green
- Birds	- Baker, Francis, Hebert
- Mammals	- Fenton
Plants	- Barrett*, Graham, Husband, Newmaster
Protists	- Saunders*, Beaton, Kaczmarska, Keeling, Lynn
Fungi	- Hickey*, Levesque, Seifert, Hamelin, Moncalvo
DNA & Databasing	- Golding*, Crease, Hebert, Hickey

\*Indicates a designated research team leader (Hebert leads the animal research program)

## **FUNDING**

Direct funding for the Network currently exceeds \$24M. Major sources of support include the Canada Foundation for Innovation/Ontario Innovation Trust (\$9.8M for construction and support of the Biodiversity Institute of Ontario) and the Gordon and Betty Moore Foundation (\$3M for Core Sequencing Facility and barcode analysis). Support for the Network’s 38 principal investigators comes from two primary sources - the Natural Sciences and Engineering Research Council (\$4.9M over 5 years) and Genome Canada (\$5.5M over 5 years). Additional contributions (\$1M) have been secured from various federal agencies and private sector organizations as part of our co-

funding strategy. The Network will directly support the training of 23 post-doctoral fellows and 18 graduate students. Key milestones achieved for Year 1 include the establishment of specimen supply chains and the barcode analysis of over 5000 specimens, representing approximately 1500 species.