Genomics for Biodiversity

The *ArkChip*: multi-species genome sequencing for Conservation Genomics

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[http://www.mun.ca/biology/scarr/ArkChip_for_COSEWIC.html]

Abstract

In the study of **Species-at-Risk**, the degree to which the loss or decline of local populations affects others and threatens species extinction depends critically on the spatial scale of population differentiation and gene flow. **Phylogeographic analysis of mitochondrial DNA sequences** can provide extremely detailed information on the fine-scale population structure of species, which can inform decisions about the biological independence of "***Designatable Units***" in species that are considered ***Endangered***, ***Threatened*** or of ***Special Concern*** by **COSEWIC** under **SARA**.

Single-locus studies may of **mtDNA** often lack sufficient detail, and analysis of **complete mtDNA genomes** by conventional methods remains laborious. The use of **microarray "DNA chips"** for ***"DNA re-sequencing"*** of new individuals with respect to a reference sequence allows generation of **complete individual mtDNA sequences** in a single experiment. Experiments with a first-generation **30Kbp human mtDNA** microchip show that the method is efficient, accurate, and cost effective. ***We propose to develop DNA re-sequencing technology as a practical method for assessing the genetic structure of DFO fisheries species and SARA Species-at-Risk***. As a "*proof of principle*" experiment, we will design a **DNA** microchip for the **Atlantic cod mtDNA genome**, and use it to extend our genomics study of the **stock structure** and **phylogeography of Atlantic Cod**.

A second-generation, **multi-species *"ArkChip"*** will include **up to 300,000bp** on a single chip that accommodates **up to 20 species' mtDNA genomes**. Use of the extensive database of **reference mtDNA genomes (n > 400)** allows experiments to be standardized; available **nucDNA** loci can be incorporated. Costs of each component project (*e.g.*, **Wolffish**) are reduced proportionately. A breakthrough into high-throughput genomics would enable cost-effective, co-ordinated investigation of **multiple species** of interest to Species-at-Risk agencies, managers, and recovery teams.

The "*ArkChip*" Concept
***"Helix & Primer"* genomics laboratory**
Bio4900 - Fundamentals of Genetic Biotechnology
(three-week short course offered **15 Aug - 02 Sept 2005)**

Genomics: the study of **complete gene sets** in organisms
"***Genomic Thinking***": **high-throughput**, **massively-parallel** approaches
Biodiversity Genomics: **intra-** & **inter-specific** variation in **DNA genomes**
genomic approaches to **fisheries, conservation & population biology**
***Ex.*: Population & Stock Structure** in **Atlantic Cod**

High-throughput, massively parallel biotechnology: *"DNA Chips"*
DNA Re-Sequencing Chips for **biodiversity**
The *Arkchip*: multiplex, multi-species DNA sequence detection

Strategies for obtaining mtDNA genomes of **novel species**:
***Ex.*: Long-Range PCR & "*leap-frog*" sequencing** of **Wolffish**
