

2004

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## **Managing the Genetic Diversity of an Arctic Charr Broodstock**

Colin McGowan<sup>1</sup>, Amit Goel<sup>1</sup>, Evelyn Davidson<sup>1</sup>, Andrea Mosher<sup>1</sup>, Siemon Ng<sup>1</sup>, Eric Johnson<sup>2</sup>, Jonathan Lucas<sup>2</sup>, Dave Desmarais<sup>2</sup>, Michael Edwards<sup>2</sup>, John Rose<sup>2</sup> and William Davidson<sup>1</sup>

<sup>1</sup>*Department of Molecular Biology and Biochemistry, Simon Fraser University, Burnaby, B.C.*

<sup>2</sup>*Icy Waters Arctic Charr Limited, Whitehorse, Yukon*

Icy Waters Ltd. is a privately owned Canadian company and a world leader in Arctic charr (*Salvelinus alpinus*) aquaculture. It is committed to the belief that Arctic charr are one of the finest freshwater finfish in the marketplace today. Located in Whitehorse, Yukon Territory, Icy Waters Ltd. is a fully integrated operation that includes a certified broodstock facility, hatchery, tank farm and processing plant. Since its establishment in 1986, a strong broodstock development program has been a cornerstone for Icy Water's success. In 2001, Icy Waters aspired to broaden their breeding program to include molecular genetics and marker-assisted selection (MAS). In collaboration with Simon Fraser University and with funding from Canada's National Research Council Industrial Research Assistance Program (NRC-IRAP), the Icy Waters Arctic Charr Broodstock Enhancement Project was started. Over the past three years, the goal of this project has been to discover genetic markers that can be used to increase the efficiency of breeding strategies through the implementation of marker-assisted selection.

Two hundred and fifteen different genetic markers have been tested on Icy Waters Arctic charr to establish if they can provide sufficient information for the genetic analysis of the broodstock. Eight markers were chosen to obtain baseline data about the genetic diversity of these populations and to estimate the genetic relationship of all pairs of individuals in the broodstock. These eight markers have also been used to genetically 'fingerprint' parents and offspring in order to establish pedigrees. Sixty markers provide sufficient information to screen the mapped regions of the Arctic charr genome for the location of genes responsible for commercially important traits such as growth, disease resistance, high temperature tolerance or sex. Nine markers were found to have significant or near significant association with genes responsible for growth rate. Two genetic markers were tightly linked to the male sex-determining factor.

The ability to genetically fingerprint pedigreed fish will allow Icy Waters to field test the performance of various crosses and families that are generated in the Whitehorse facility. This information can be incorporated into the current breeding program and used to generate lines of fish that are customized for particular environments. This information can also be used to avoid inbreeding between closely related individuals and to maintain maximum levels of genetic variability in the hatchery.

The discovery of sex-linked markers will provide substantial financial savings to Icy Waters through the elimination of male fish from egg production. Also, the ability to cull males at an early age will diminish the environmental impact of the hatchery by cutting in half the number of fish it needs to maintain.

Genetic markers linked to growth genes can be used to increase the frequency of fast growth genes in the overall population through marker-assisted selection, or to transfer fast growth genes from one purebred line to the other through marker-assisted introgression. Other important traits under investigation include disease resistance, pigment uptake, upper temperature tolerance and coloration.