

# DNA marker tool to reduce IPN in Atlantic salmon



Thomas Moen, Aqua Gen, Norway

Viral diseases constitute one of the major problems of the Atlantic farming industry worldwide. While most bacterial diseases have been successfully combated with vaccines, viral diseases continue to cause large mortalities, and existing vaccines often have limited effects. To make aquacultured Atlantic salmon stocks more resistant to infectious pancreatic necrosis (IPN), one of the most problematic viral diseases, selective breeding is being used. The Norwegian breeding company Aqua Gen in collaboration with CIGENE and Nofima identified DNA markers associated with resistance to IPN, and subsequently these markers were used in order to develop a more IPN-resistant strain of Atlantic salmon.

## Prediction of the salmon's resistance to IPN

The Atlantic salmon was scanned for quantitative trait loci (QTL) that are affecting the salmon's resistance to IPN, by performing a genome-scan. The genome scan revealed that the majority of variation in resistance is explained by a single locus. A DNA-marker-based tool was developed that can be used to predict the genotype of the QTN (the DNA variant underlying the QTL). The test can be applied to almost all animals derived from the breeding population in question, and the predicted genotypes have been shown to be very precise. The deduced QTN genotypes have been shown to be highly predictive of the salmon's resistance to IPN (Figure 1).

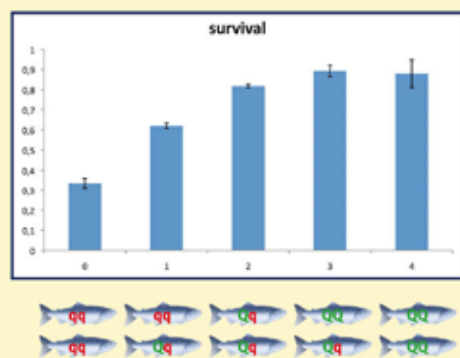


Figure 1: Survival rates in IPN challenge test of animals, grouped according to genotypes of parents



## Practical implementation of the DNA marker tool

The test has been implemented in Aqua Gen's commercial production of Atlantic salmon eggs under the name of QTL-innOva, starting from 2009. A large-scale benchmarking project has since then been monitoring the performance of QTL-innOva and standard eggs, revealing that the use of Atlantic salmon farmers QTL-innOva eggs has led to markedly fewer IPN outbreaks at the farms they are used (Figure 2). Due to the Atlantic salmon farmers' good experiences with the IPN-resistant eggs, the demand for the product has increased every year, currently making up almost the entire Aqua Gen production. The introduction of QTL-innOva eggs in Aqua Gen's production has led to a dramatic decrease in the number of IPN outbreaks in the Norwegian industry as a whole (Figure 3).



Figure 2: QTL-innOva Field documentation 09/10 fresh water



Figure 3: IPN outbreaks in the Norwegian industry

## Future perspectives

An ongoing project has made a 10 million base pair long contiguous sequence of the region surrounding the QTN, and identified several single nucleotide polymorphisms (SNPs) or short insertions in very close linkage disequilibrium (LD) with the QTN. However, no clear biological hypothesis has yet been found, implying that the QTL may be connected to a more complex polymorphism. Motivated by the possibility of understanding more about the factors creating resistance to IPN, the search for the underlying, causative mutation, continues. For practical purposes, however, the DNA marker tool used for selection is almost as good as it could be (the correlation coefficient between the QTN and the marker used for selection 0.9).

## Main outcomes

- DNA marker test
- Selection for IPN-resistant Atlantic salmon
- Decrease IPN outbreaks in Atlantic salmon