# Improving disease resistance in salmon

**The Biosciences KTN has assisted the UK's premier salmon breeding company in the groundbreaking use of genomic technologies to produce salmon with reduced susceptibility to disease.**

## The need

Disease susceptibility is a major threat to the global salmon farming industry. The fish are generally reared in pens that are tethered to the sea bed and controlling exposure to pathogens and diseases is consequently very difficult. When a disease occurs it can have catastrophic consequences. For example, in 2007, infection with Infectious Salmon Anaemia virus caused major decimation and near collapse of the Chilean salmon farming industry (the second largest global producer in 2006).

Increasing the salmon's robustness to diseases and pathogen challenges is therefore a major driver for the industry. The ability to provide stock with high resistance to specific diseases can confer a significant competitive advantage to a salmon breeder.

## The results

Landcatch Natural Selection (LNS) is the UK's premier aquaculture breeding company, selling young stock and eggs globally. LNS employ a selective breeding programme that allows them to deliver year on year genetic improvement for a range of important characteristics.

The availability of new genomic tools offers the potential for LNS to accelerate the rate of improvement within their breeding programmes and allows selection for important characteristics, such as resistance to disease.

A collaborative project between LNS and SAC, funded by a Biosciences KTN SPARK Award, helped develop a database to hold and analyse genetic and genomic data. The Biosciences KTN then assisted LNS to secure a Knowledge Transfer Partnership (KTP) project with The Roslin Institute that has resulted in the company being able to successfully use marker-assisted selection to breed fish that have a high level of resistance to infectious pancreatic necrosis virus (IPNv, Figure 1), which can cause devastation to salmon stocks.

LNS secured a further SPARK award to collaborate with the University of Glasgow to investigate whether the approach could also be extended to help breed salmon that have a high level of resistance to sea lice; parasites which are estimated to cost the global industry €300m per year.

Following this review, LNS are now leading a collaborative research project part funded by a £323k grant won through the Technology Strategy Board Genomes UK competition. The project will see the first high-density salmon single nucleotide polymorphism (SNP) chip (~100k) being used in the selective breeding of salmon, in the first instance to improve resistance to the sea louse.

This project should enable LNS to be the first global company to market sea lice resistant stock selected using this technology. This achievement could see LNS's share of the global market increase to 20% by 2015 leading to an **increase in turnover of $9m**.

## The journey so far

- LNS undertake a SPARK Award project with SAC to develop a genomic database for salmon: **project value £20,000 (grant £5,000)**
- Utilising the database and collaborating with The Roslin Institute through a KTP, LNS use marker assisted selection to develop IPN resistant stock: **project value £648,742 (grant £325,054)**
- LNS secure a SPARK Award for a collaboration with University of Glasgow to review the options for developing sea louse resistance: **project value £10,000 (grant £5,000)**
- LNS lead a collaborative project to develop and utilise the first high density salmon SNP chip to improve resistance to sea lice: **project value £647,339 (grant £323,670)**

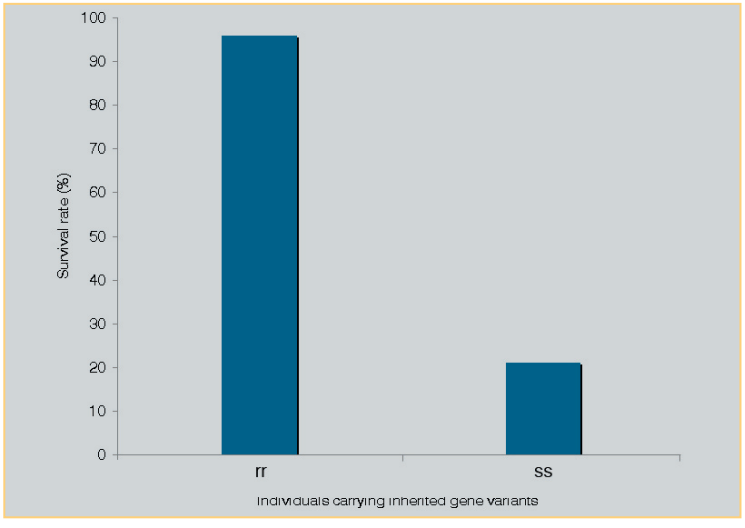
### Where next?

By developing new genomic tools such as the high density salmon SNP chip and incorporating them into their breeding programme, LNS can continue to make advances in disease resistance as well as other economically important traits such as improved feed efficiency and pigmentation.

Global demand for salmon eggs in 2010 alone was 600m and is projected to rise to 1bn eggs by 2015, worth over $60m.

More locally, farmed salmon is the largest food export from Scotland and has an annual retail sales value of around £1bn. Scotland is the largest aquaculture producer in the EU.

## Developing IPN resistance in salmon

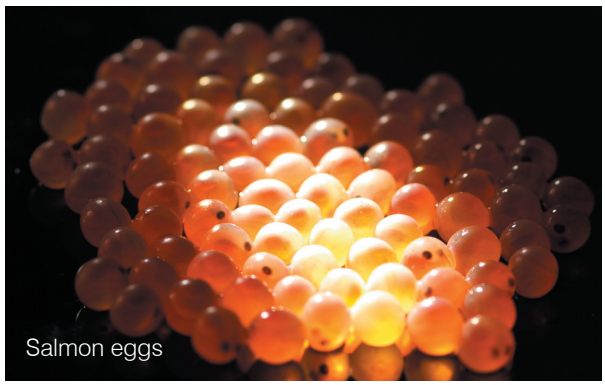



*An IPN virus infectivity trial revealed a marked increase in the survival rate of individuals carrying the favourable, IPNv resistant, gene variant (rr) versus those carrying the susceptible gene variant (ss).*

LANDCATCH Natural Selection

"This work demonstrates how genomic analysis can be applied to real-world farming problems resulting in improved animal welfare and performance of a key farmed species"

**Alastair Hamilton,**
Head of Molecular Biology at LNS.


Salmon eggs

## Project Details

**Project partners:**

Landcatch Natural Selection

SAC

Affymetrix UK Ltd

The Roslin Institute and the Royal (Dick) School of Veterinary Studies (University of Edinburgh)

The University of Stirling

The University of Glasgow

**Project investment:**

Biosciences KTN: £10,000

Total investment in R&D: £1,326,081

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