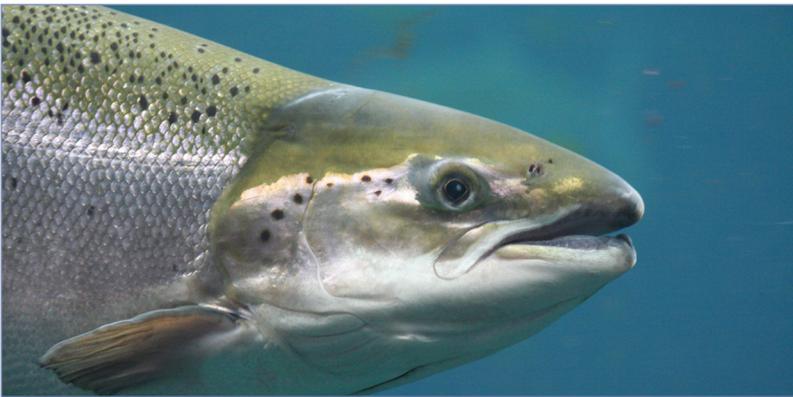


BREEDING SALMON FOR RESISTANCE TO INFECTIOUS PANCREATIC NECROSIS



The viral disease infectious pancreatic necrosis (IPN) has been a major constraint on salmon aquaculture. BBSRC-funded research led by Professors Stephen Bishop, John Woolliams and Chris Haley at the University of Edinburgh's Roslin Institute demonstrated that host resistance is a heritable trait and that observed genetic differences are almost entirely due to variation in a single quantitative trait locus (QTL) of the salmon genome. The large effect of the QTL on resistance was consistent in seawater cages and in controlled freshwater disease-challenge experiments. Fish inheriting two copies of the resistant variant of the QTL from their parents have negligible mortality, whereas those receiving the susceptible variant from both parents have mortality levels higher than 50% during epidemics. The disease resistance effect does not appear to show any negative correlations with other economically important production traits.

Dr Ross Houston has continued the research using high-throughput sequencing technology to study differences in DNA and RNA sequence between salmon carrying resistant alleles and those carrying susceptible alleles. This has enabled detection of more closely linked single nucleotide polymorphism (SNP) markers that show association with resistance to the IPN virus at the population level.

Incorporation of these improved markers into industry selective breeding programmes has further improved the accuracy and simplicity of genetic tests that enable the identification of IPN-resistant fish at an early stage.

IMPACTING SALMON FARMING WORLDWIDE



Infectious pancreatic necrosis (IPN) outbreaks can affect salmon farms in Scotland, Norway, Chile and other salmon-producing countries. Typical mortality levels in an epidemic are ~25%, and severe outbreaks are known to kill as many as 80-90% of farmed fish. No vaccine is effective in very young fish.

As a result of the University of Edinburgh's research, genetic markers have been identified that enable selection of salmon lines with improved IPN virus resistance, which is estimated to be worth ~£26 million/annum GVA to the UK economy.



ECONOMIC BENEFIT TO THE SALMON FARMING INDUSTRY



In 2008 the salmon-breeding company Landcatch Natural Selection (LNS) Ltd, implemented marker-assisted selection (MAS) for IPN resistance when selecting its elite and commercial salmon populations. This is one of the first successful documented example of MAS in any aquaculture species. A license agreement between The Roslin Institute and LNS enabled a molecular genetic test for IPN resistance incorporating the QTL resistance markers to be sold internationally to aquaculture companies.

IPN resistance, using MAS, can reduce IPN mortality by 25% (i.e. from ~25% on average to virtually zero). After taking account of the market share of LNS for the eggs and smolts required by UK salmon industry, this equates to an economic impact of £26.4 million GVA (comprising reduced costs and losses, as well as greater output of marketable salmon) and between 360 and 450 jobs across the UK. As LNS also supplies 15%-20% of the eggs and smolts required by the global salmon farming industry, similar impacts can be documented overseas.

Salmon farming is heavily concentrated in the Scottish Highlands and Islands, and therefore provides employment in some of the remotest communities in the UK where few alternative opportunities exist. Severe outbreaks of IPN are potentially devastating for such communities; hence this research supports these fragile rural communities.

Implementation of the findings also reduces the ecological impact of salmon farming as IPN is an endemic infectious disease that affects both wild and farmed salmon.

FISH N [SNP] CHIPS

The research translation process has served as a paradigm for other economically important diseases. LNS Ltd received funding from the TSB / BBSRC Genomes UK: Exploiting the Potential of High-Throughput Sequencing competition to develop a high-density salmon SNP chip, which will be a key tool for improving the competitiveness and sustainability of the UK salmon farming industry. These SNP arrays are now being utilised to select salmon for increased resistance to sea louse infestations. Both the SNP chip and the IPN resistance research has involved several collaborators including Edinburgh Genomics, the Universities of Stirling and Glasgow, and industry partners Landcatch Natural Selection and Affymetrix Ltd.



CONTACT

The Roslin Institute
The University of Edinburgh
Easter Bush Campus
Midlothian, EH25 9RG
T: 0131 651 9100
E: info@roslin.ed.ac.uk
www.roslin.ed.ac.uk

If you require this document in an alternative format, such as large print, please contact info@roslin.ed.ac.uk



THE UNIVERSITY of EDINBURGH