"SALIMPACT"

The impact of salmon farming on the genetic variation in wild populations of Atlantic salmon and brown trout

Disease outbreaks are a common phenomenon in aquaculture conditions. However, the impact of diseases transmitted through the contact between wild fish and farmed fish has been sparsely documented.

The aim of SALIMPACT was to assess the extent to which disease transmission from Atlantic salmon aquaculture affected genetic variation in natural populations of Atlantic salmon and brown trout.

There are several possible modes of disease transmission from cultured stocks to natural populations. In the case of salmonids, transmission can occur as Atlantic salmon (*Salmo salar*) and anadromous brown trout (*Salmo trutta*) migrate past sea-cages of farmed salmon in which there is a disease outbreak. Alternatively, fish carrying disease (either overt or as carrier) may escape from sea-cages and enter wild populations, or may be released as part of a restocking programme. In addition, wild populations may be affected by pathogens released in wastewater from hatcheries within the drainage systems.

In the project, seven case studies were selected in Norway and Ireland, all involving salmonid populations affected by either a disease epidemic or introduction of farmed Atlantic salmon. For each of them, the impact of aquaculture was directly examined by comparison of present-day populations which are known to have been impacted by aquaculture with either adjacent populations that have no history of impact (**spatial analysis**), or with samples taken from the same population before any impact of aquaculture (**temporal analysis**).

Research focused on certain immune response genes known as the **class I and class II major histocompatibility (MH) genes**, genes known to have a well-established role within the immune system. For salmonids these genes show extensive **polymorphism**, meaning that, for a certain trait, several phenotypic forms associated with alleles of one gene can occur in a population (or among populations). MH polymorphism **correlates with fitness traits such as disease resistance/ susceptibility and thus survival**.

To allow assessments of potential fitness consequence of disease impacts on MH variability in natural populations, the spatial and temporal analyses were complemented by **field experiments testing for fitness differences** among MH genotypes.

From the spatial analysis, there appeared to be **less genetic diversity of MH genes in rivers with a history of aquaculture compared to those with no aquaculture**. The temporal analysis did not show major genetic differences between populations before and during aquaculture activity. However, MH gene variability was generally higher before the advent of

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"FROM THE SPATIAL ANALYSIS, THERE APPEARED TO BE LESS GENETIC DIVERSITY OF MH GENES IN RIVERS WITH A HISTORY OF AQUACULTURE COMPARED TO THOSE WITH NO AQUACULTURE"

aquaculture. Results from the field experiments indicated that Atlantic **salmon populations have the best chance of fighting disease outbreaks if MH variability is high**, as it is impossible to predict which MH alleles will be advantageous at any particular time. Therefore, **MH variability should be maintained to ensure the genetic potential of locally adapted salmonid populations**.

The large diversity in morphology, behaviour and life-history patterns among local salmonid populations has for long been recognized as evidence of **adaptations to local environmental conditions**. The case studies and field experiments conducted under SALIMPACT have now also provided **genetic evidence for this adaptation in brown trout and Atlantic salmon**.

In addition to this, tools have been developed **to maintain the genetic variation in relation to local adaptation using major histocompatibility gene markers**. The general goal of **conserving biological diversity at all levels from genes to ecosystems** has been established internationally, and, for instance, applies to all nations that have ratified the **Convention on Biological Diversity (Rio de Janeiro, 1992)**. Most European countries, including the EC, have ratified this convention, which stresses that "States are responsible for conserving their biological diversity and for using their biological resources in a sustainable manner".

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