MARINE RESEARCH NEWS

Sea lice — can we breed "resistant" salmon?

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Together with Aqua Gen AS, scientists at the Institute of Marine Research (IMR) in Bergen are investigating the possibility of reducing the vulnerability of farmed salmon to lice through selective breeding.

The principal method by which lice on cage-reared salmonids are controlled is through the use of chemicals. However, several cases of "resistance" to delousing agents have already been documented, and alternative control methods will be needed in the future. Selective breeding has helped the Norwegian salmon culture industry develop from its infancy in the late sixties into its world-leading position today. At present, Aqua Gen is successfully selecting for resistance to infectious salmon anaemia (ISA), infectious pancreatic necrosis (IPN), and the bacterial disease furunculosis. Could selective breeding develop a salmon strain that would display resistance to lice?

GENETIC CONTROL OF SUSCEPTIBILITY

The estimation of heritability, loosely defined as the degree of genetic control over a trait, is the first step in a breeding programme. Experiments at IMR have demonstrated that a genetic component in susceptibility to lice exists in salmon (Figure 1). In theory, this should allow us to select salmon that suffer

Female salmon lice with egg strings.

A clear difference in infection level: but does this reflect resistance?

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lower than average infection levels, and to use these individuals for breeding. By passing on "positive" genes from generation to generation, their frequency will increase in the selected population, leading to greater resistance.

IS IT REALLY THAT SIMPLE?

Unfortunately, no. Many known and unknown factors influence lice infection levels, and these need to be understood and controlled if selection is to give results. For example, larger fish often display higher lice counts than smaller fish. However, this is a consequence of the greater surface area available for lice to attach to, and not due to a higher susceptibility. While identified factors can be controlled for, unidentified factors cannot. Furthermore, practical constraints may not be so easy to deal with. Is it realistic to expect humans to routinely and accurately count lice on thousands of salmon in order to identify resistant individuals? What if there are too few lice in the sea when the sample is taken?

WHEN TO SAMPLE

It is not the numbers of lice at a specific point in the rearing cycle that is important to the farmer per se, but rather the accumulated numbers of lice that have existed on the fish during the entire cage-rearing period. While data have shown that group differences may be stable over time, relative levels of infection in individual fish are unstable (Figure 2). This may not be an issue for selection where resistant families would be identified from data collected from a number of siblings, but it presents a problem where individual selection is practised.

TIME IS MONEY...

One major drawback with selective breeding is that it takes time. The generation cycle of Atlantic salmon in culture is usually four years long. It is possible that other delousing chemicals or economically viable control methods will be available before a potential breeding programme could sufficiently increase resistance in farmed salmon. But what is meant by "sufficient"? A selected stock will only save farmers money when the level of resistance is high enough to reduce the frequency of delousing. Due to restrictions on the numbers of lice permitted on farmed fish, and the high numbers of lice that exist, it is unlikely that a selected stock would start to save the industry a significant number of medicinal treatments before several generations of selection have passed.

In summary, whilst production of a salmon strain displaying reduced susceptibility to lice is theoretically possible through selective breeding, financial, time and practical constraints may limit the usefulness of this approach in the struggle to control lice. Vaccines, new medicines and better management strategies will be needed.

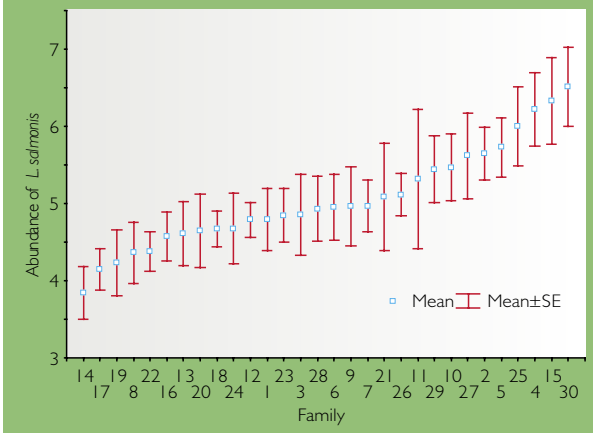

Figure 1. Average abundance of salmon lice in 30 Atlantic salmon families. Families on the left-hand side of the graph are least infected, and would be selected to breed from.

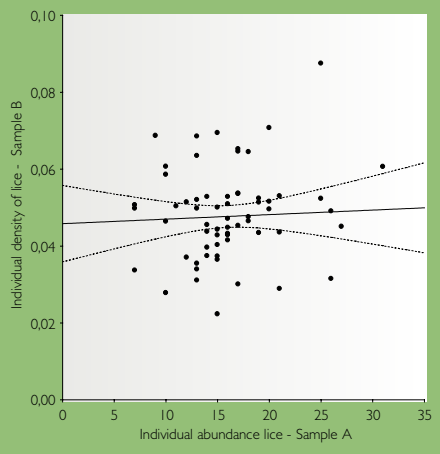

Figure 2. An individual's infection level in the first sample is a poor predictor of its infection level in a sample taken at a later date. In practical terms, this means that identifying individual salmon that display genuine resistance to lice is difficult.

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