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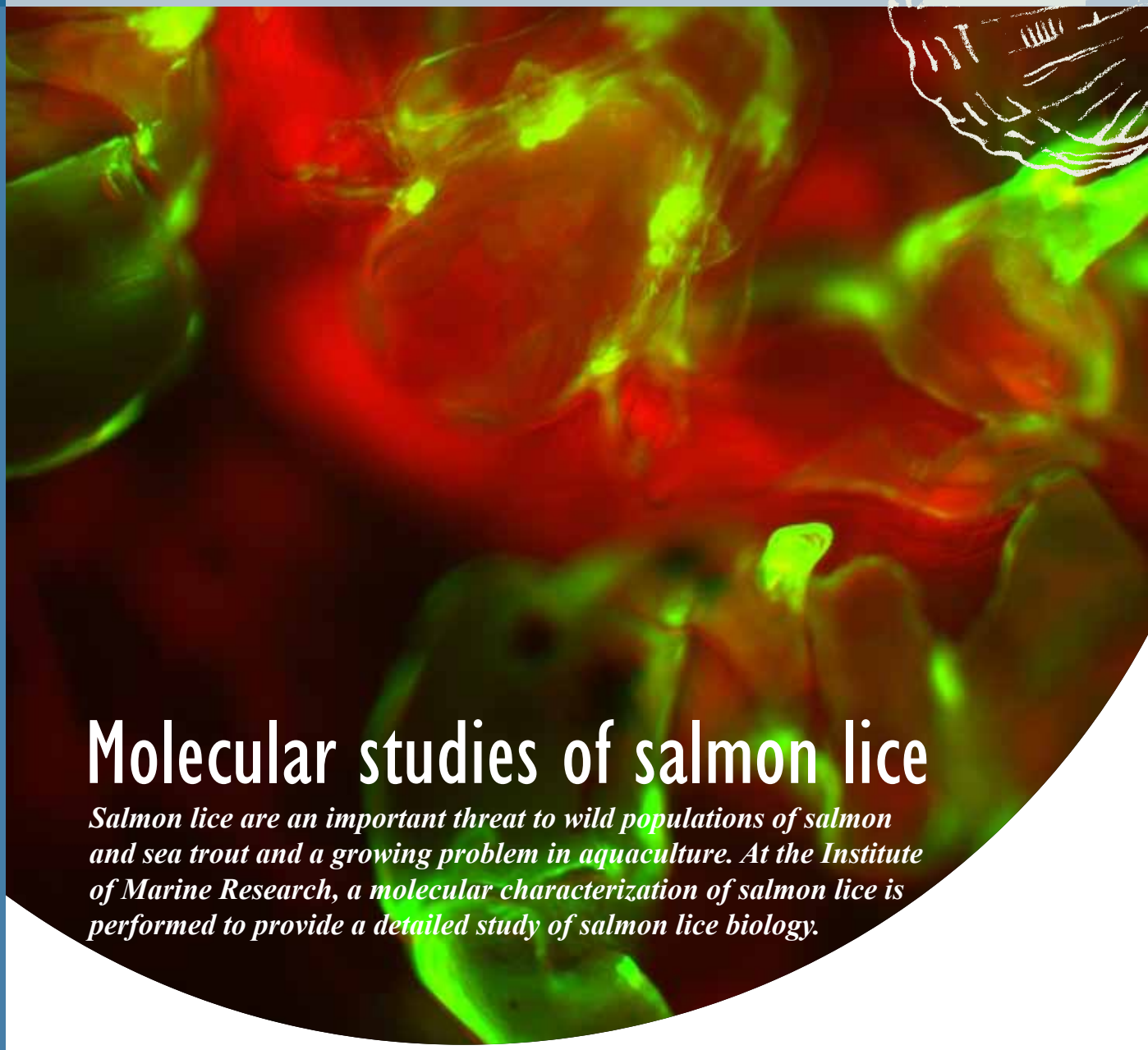

Molecular studies of salmon lice

Salmon lice are an important threat to wild populations of salmon and sea trout and a growing problem in aquaculture. At the Institute of Marine Research, a molecular characterization of salmon lice is performed to provide a detailed study of salmon lice biology.

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Salmon lice eat the skin, mucus and blood of its host and thereby affecting the immune system of the fish. In addition, large numbers of lice on the fish can produce skin lesions causing osmotic stress and susceptibility to infections.

In aquaculture, the prevalence of salmon lice is currently controlled by drugs affecting the nervous system of the salmon lice. Several cases of resistance against this group of drugs have been reported recently in Norway, and further resistance problems can be expected to develop as a result of the increase in aquaculture activities. Treatments against salmon lice, whether chemical or vaccine based, functions by blocking or modifying essential molecular processes in the salmon louse. Research at IMR has therefore focused on describing life processes in the salmon louse on a molecular level. Here we will provide a simplified version of the background behind this type of molecular study and explain which types of experiments are performed.

BASIC CONCEPTS OF MOLECULAR BIOLOGY

All living organisms consist of cell(s). Cells in different parts of the body have very diverse appearance and function, but they all contain the same heredity materiel which is made from DNA. Heredity material contains all necessary information needed to control processes in the cell as well as the whole organism. Hereditary material functions as a big recipe book, which the cell can use to check how to perform new tasks. Hereditary material contains recipes (genes) which describe how products (proteins) should be produced in addition to information on when and where they should be used. Proteins are the most important raw material in the body as it can be utilized as building stones for a variety of functions including cell communication, control and accomplishment of biological process and storage of nutrition.

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HOW ARE PROTEINS PRODUCED?

When an organism needs a protein for a specific job, the cells must produce it. To do this, the cell checks the recipe in the hereditary material and produces a copy in a material called RNA. This copy is called messenger RNA. The copy is transported to the area of the cell where protein production takes place and the protein is produced according to the recipe.

Molecular techniques used routinely in the study of salmon lice at the laboratories at IMR:

1) Sequencing of the hereditary material. Sequencing reveals the information stored in the hereditary material, thus it is possible to determine which proteins the organism is capable of producing. This type of information can be utilized for studies of evolution or to determine which species the samples originates from. It is also used for studies of species specific biological processes.
2) Studies of messenger RNA from individual organisms provide information about which genes were expressed exactly at the time when the sample was collected. This is possible because messenger RNA is very unstable and only present in the organism during the process of protein production. In addition, it is possible to measure the quantity and location and timing of messenger RNA.
3) Studies of proteins provide information on the location, amount and temporal distribution of proteins. Together with the results from studies of messenger RNA, it is possible to assess the life situation of the organism in a quantifiable way. These type of studies can therefore be used in a wide range of studies both applying to development, biological processes, interactions between organisms, but also for example to look into environmental effects of pollution on the organism.

MOLECULAR MANIPULATIONS

A cell in need of a protein can produce it following the instructions found in the hereditary material. But cells or organisms can also be manipulated to selectively destroy certain messenger RNAs and thereby terminate production of specific proteins. This method is called RNA interference (RNAi). Using this method we can observe how an organism reacts when the protein is not present. This reaction can provide indications of the function on the protein. The RNAi method doesn't function in all organisms, but has successfully been applied to salmon lice at IMR. Here, RNAi has been used to turn off protein production for extended periods of time (Figure 1).

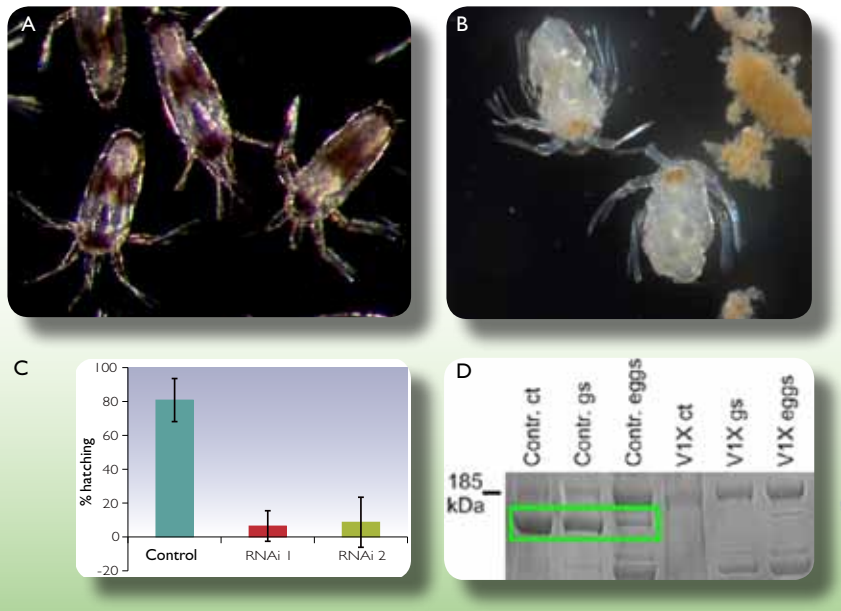

Figure 1:
Results of an RNA interference experiment. The messenger RNA from a specific gene has been destroyed, and the expression of this gene has been suppressed. The salmon louse larva cannot develop normally and are not able to survive.
A: Normal salmon louse larva.
B: Manipulated salmon louse larva. C: Hatching success of manipulated lice in comparison to non-manipulated lice. About 80% of all eggs hatched normal lice (control), less than 10% hatched in manipulated lice (RNAi1 and RNAi2).
D: Proteins isolated from lice and egg of normal lice (three columns on the left) and from manipulated lice (three columns on the right). While the specific protein is present in normal lice and egg (green box), it is absent in the manipulated ones.

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