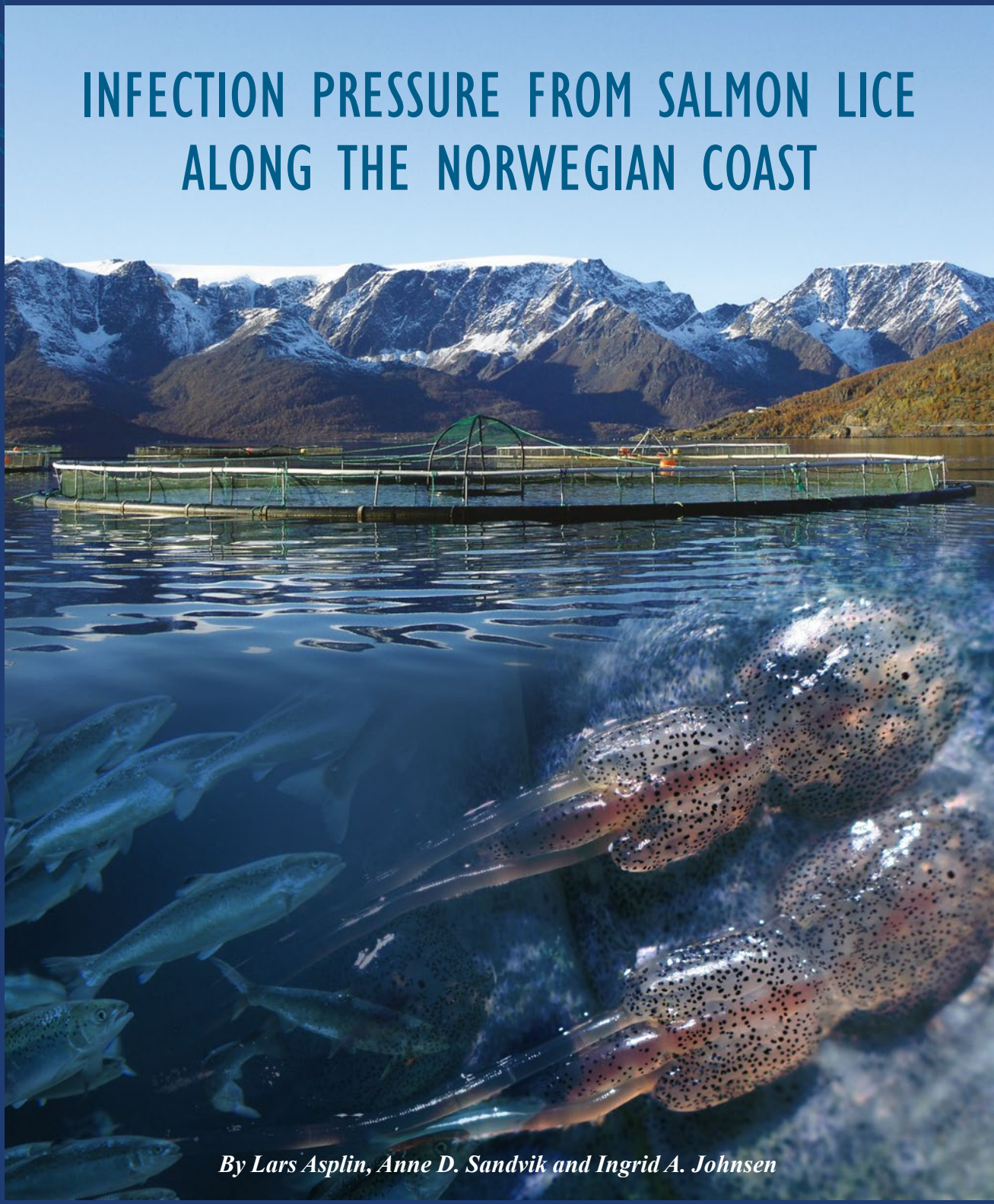
2–2017

FOCUS ON MARINE RESEARCH

INFECTION PRESSURE FROM SALMON LICE ALONG THE NORWEGIAN COAST



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A central premise for growth in Norwegian aquaculture is control of salmon lice. Protection of wild salmonid populations against undue pressure from salmon lice mainly produced in fish farms is a key tenet of the new management regime for aquaculture.

Aquaculture growth will from now be sustainable, and an important index of sustainability is the carrying capacity of salmon lice on the wild fish populations. Norway is divided into 13 aquaculture production areas (Figure 1). An expert group will every second year give advice on the conditions for each production area, and especially the infestation pressure on the wild fish from salmon lice and the conditions of the wild salmon populations.

The Ministry of Trade, Industry and Fisheries will, based on the advises from the expert group, determine for every production area whether the aquaculture can grow or not.

Figure 1: The 13 production areas that the coast is divided into.

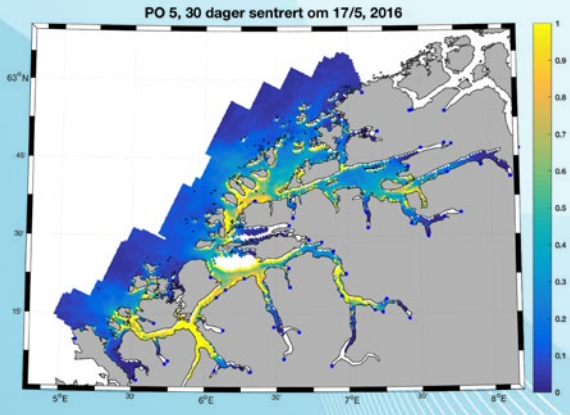

Figure 2: The density of the planktonic salmon lice estimated from the model in the Production area 5 in Møre and Romsdal.

Estimating where the salmon lice are

To estimate where the salmon lice reside at any time, the Institute of Marine Research has developed a model (or a system of models) describing how the lice are distributed in the water masses. The model includes all relevant processes: Water current, water temperature, salinity as well as the growth, behaviour and mortality of the individual louse (Figure 2).

The results show where the lice reside in the fjords and on the coast, and how the distribution changes in time and with seasons. The infestation pressure of salmon lice on wild fish is proportional to the lice abundance.

Potentially large salmon lice production

The sources of salmon lice are mainly gravid female lice on farmed fish. A gravid female can have 300 eggs attached in strings that are hatched weekly. The reproduction potential for an individual is thus large.

In a fish farm containing several hundreds of thousand farmed fish, even small numbers of gravid females, also within the allowed number due to regulations, will potentially lead to hatching of millions of salmon lice nauplii.

The water borne stages of salmon lice contains two non-infestive nauplius stages lasting 3–5 days, and the infestive copepodid stage lasting another 10–15 days.

Salmon lice abundance are reported weekly

Every week the Institute of Marine Research calculate the abundance of salmon lice copepodids all along the Norwegian coast. Critical for these numbers are the reports from the industry of female lice in fish farms.

We use daily model results of current, temperature and salinity from the Norwegian Meteorological Institute and aggregate the hourly lice distributions into a weekly presentation (http://www.imr.no/forskningsdata/smittepress_lakselus/).

Natural variability of the results

The modelled infestation pressure will vary a lot, both geographically and in time. This is a result of natural conditions. Especially the season will be important since the water temperature will increase in the spring and summer. Increased water temperature leads to an increased lice production in farms and generally more salmon lice in the water.

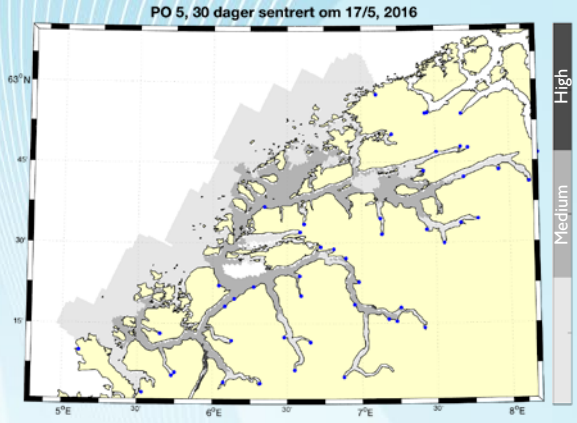

Figure 3: Infestation pressure map for production area 5 estimated for the spring 2016.

The water mass salinity will also change with the seasons, with low values in spring and summer. Low salinity, typically less than 20, will be avoided by the salmon louse, thus the wild fish might experience reduced infestation pressure in low salinity areas.

The water current varies typically from hours to days/weeks. Variable current move salmon lice around and can lead to convergence (higher concentrations) or divergence (dilution). Along land we usually find areas of higher concentration of salmon lice. Due to the variable currents, the distribution of salmon lice will not be smooth, but patchy, and the infestation will be episodic. If the wild fish meets such a patch, the risk of infestation will be large. Also, when a patch passes a fish farm, potentially many farmed fish can suddenly be infested.

The model results are a basis for the advisory process

The results from the model show where the abundance of salmon lice is high or low at any time. To better quantify the infestation pressure within the production areas, we have developed two specific products: The infestation pressure map and the virtual smolt migration.

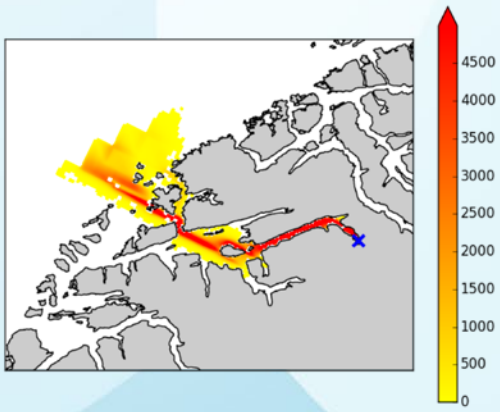

Figure 4: The migration router for the smolt from the river Eira in Romsdal. Red colour indicates the chosen route of more fish.

All results and products are made available for the expert group that assess the conditions within the production areas as advise to the ministry regarding sustainable aquaculture growth.

The infestation pressure map

The infestation pressure map illustrates the infestation pressure of salmon lice on wild fish for a given time period for every production area. Typically we produce an infestation pressure map for the smolt migration period (Figure 3).

The model results are calibrated with the observed infestation of smolt in sentinel cages, and the results are areas with high, medium and low infestation pressure.

High infestation pressure corresponds to areas where the salmonid fish risk being infested by more than 10 lice, which is regarded as lethal for a typical migrating smolt. Low infestation pressure corresponds to areas where the fish are infested by less than 1 louse.

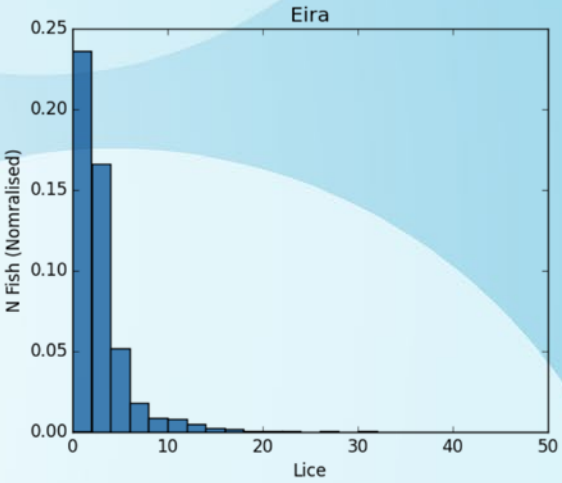

Figure 5: The proportion of potential number of lice infestations for the virtual salmon population migrating from the river Eira in 2016.

Virtual smolt migration

We simulate the migration of a wild salmon population from a given river. The encounters between the fish and the modelled salmon lice are recorded and the potential infestation for the whole population is estimated (Figure 4).

Critical conditions will be the migration route, the timing of the migration for the individual fish and the swimming speed.

The success rate of infestation is an uncertainty, and needs to be improved.

The infestation pressure for the whole population is estimated for all the important national salmon rivers (Figure 5).

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