Is intensive farming an evolutionary driver for parasites?

Author: Tomas Zapasnikas
Supervisor: Adele Mennerat
Contributors: Freya Coursey, Alexius Folk, Mathias Stølen Ugelvik

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1 What do we know?

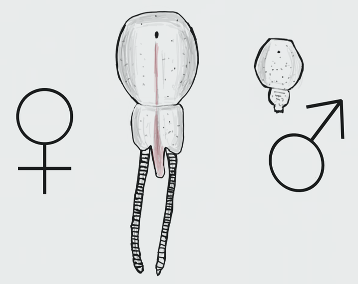
Parasites are masters at rapid adaptation. Theory predicts that they may evolve faster life histories under increasing host densities, which may result in increased virulence.[1,2]

Intensive farming of Atlantic salmon (*Salmo salar*) changes the environmental conditions for its main parasite, salmon lice (*Lepeophtheirus salmonis*).

In this experimental study we monitored the evolution of infective salmon lice larvae through seven generations of either "high" or "low" transmission level.

We expect to see:

A decrease of the body size and associated survival of larvae through generations in a "high transmission" compared to "low transmission" treatment group.



2 How to test this?

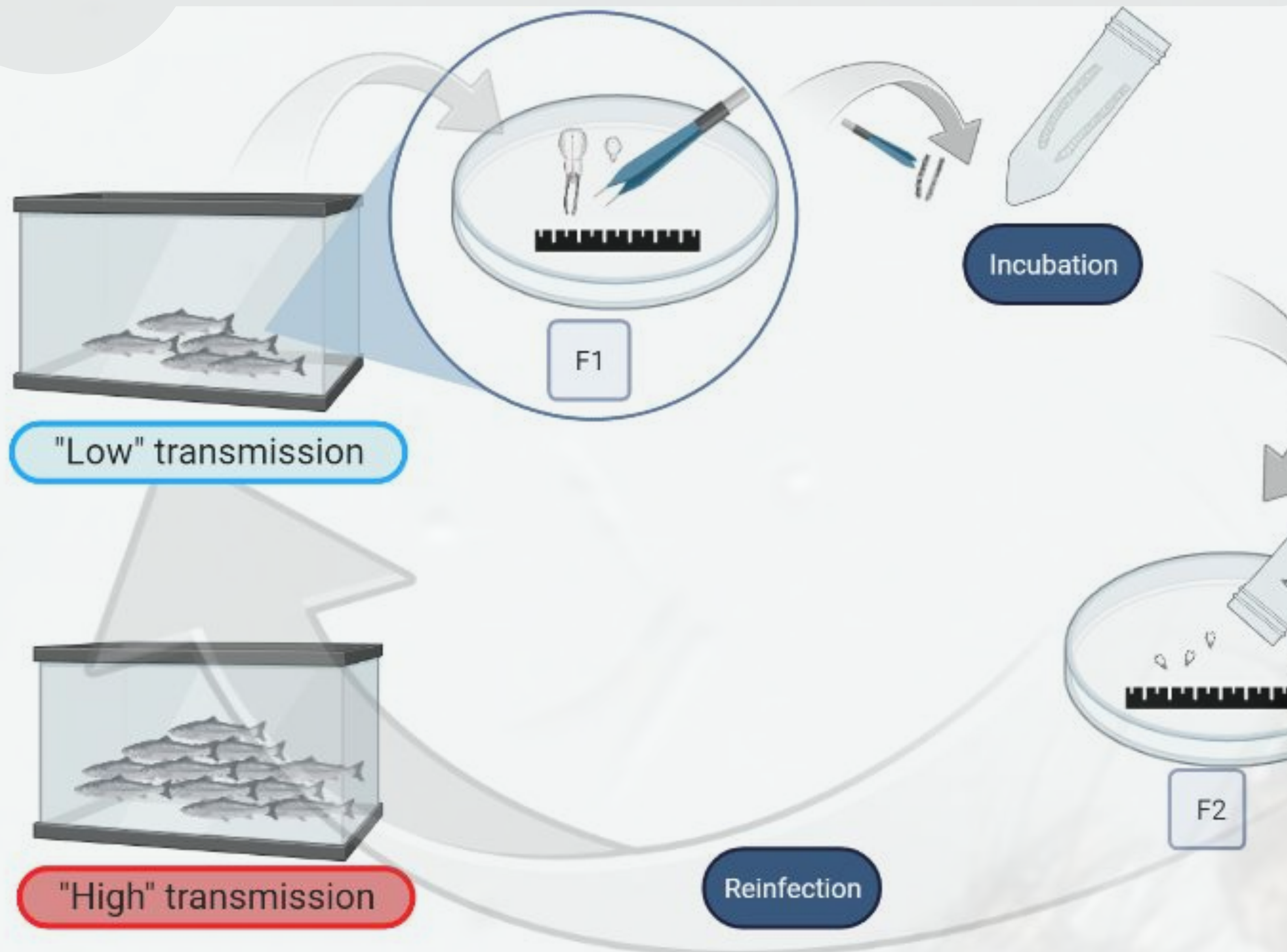


Figure 1. A schematic representation of experimental design. Two experimental groups were created with a high and a low parasite transmission chance. Larval size and survival were monitored through 7 cycles of reinfection (7 generations). Then, larval traits were compared between low and high transmission groups using generalised linear models.

Figure 2. An example of size measurement of a copepodite (larval-infectious stage). Body size is measured as the length of the cephalothorax carapace (red line).

3 What did we find?

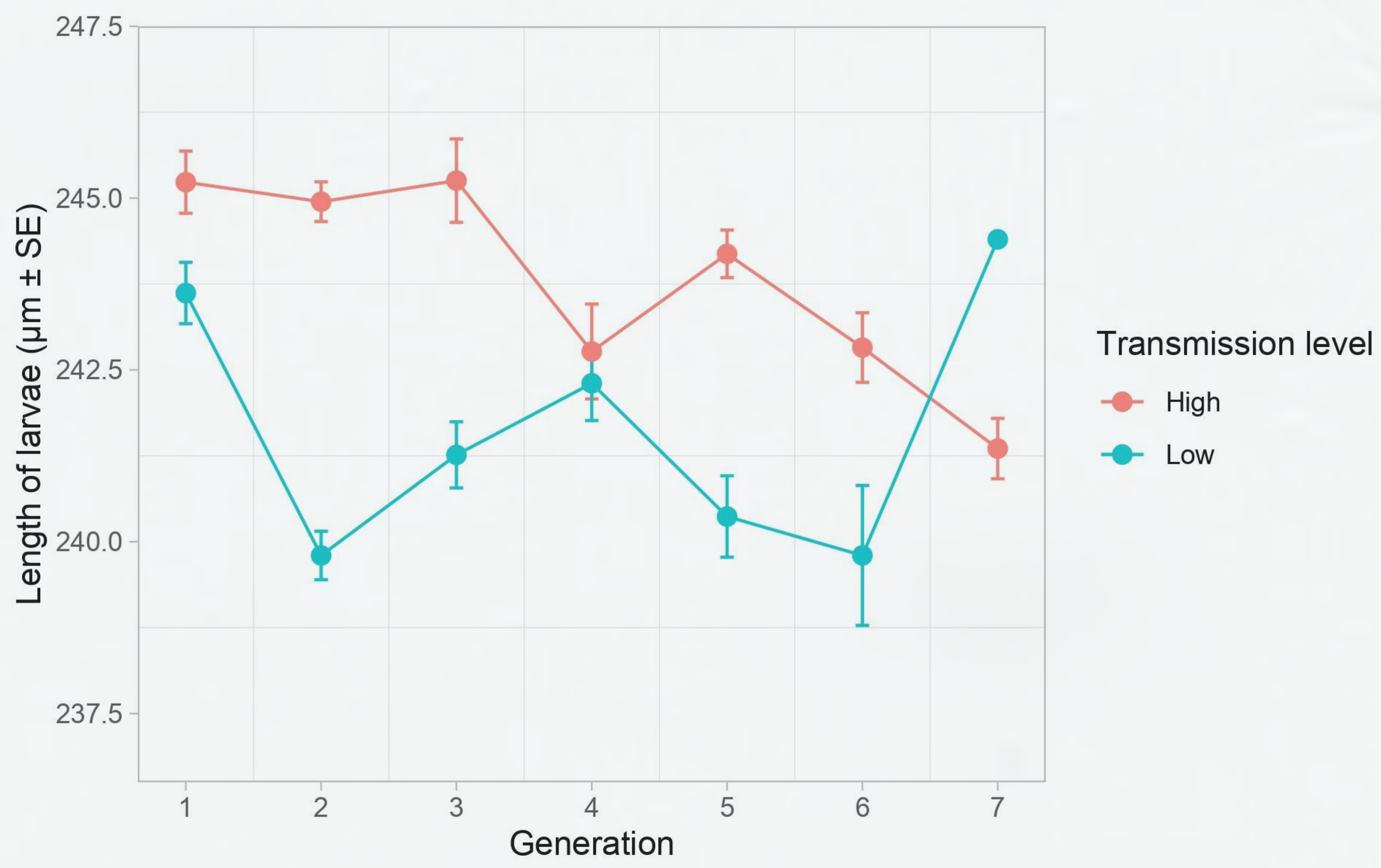


Figure 3. The evolution of length of larval cephalothorax through generations in two different treatment groups.

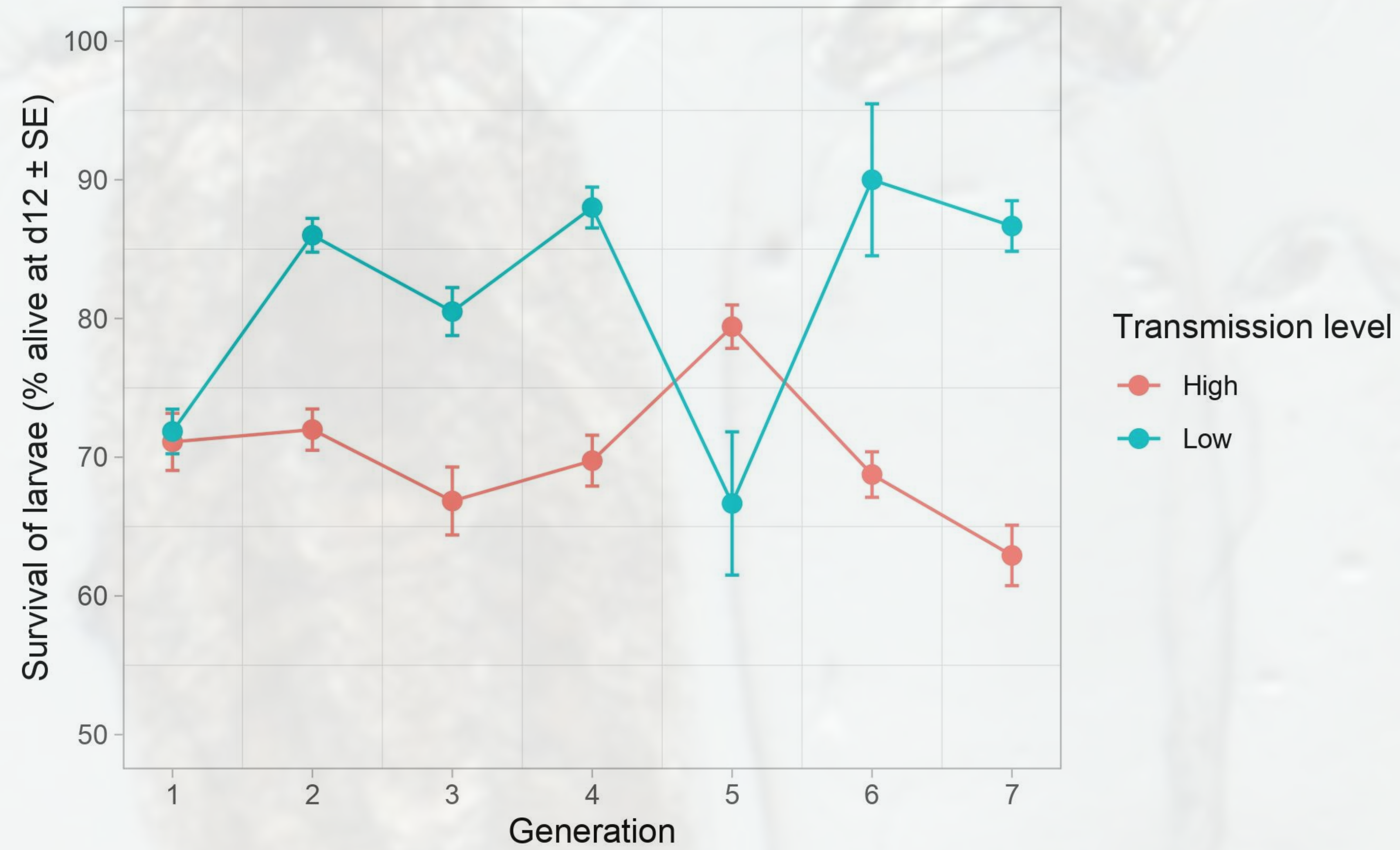


Figure 4. The evolution of larval survival through generations in two different treatment groups. Larval survival (as a percentage of alive larvae) was measured 12 days after hatching of eggs

4 What does this mean?

This study suggest that human activities such as intensive farming of fish have an evolutionary effect on parasites:

- The length of larvae decreases through generations in a high transmission group and fluctuates around the same mean in a low transmission group ($\rho < 10^{-3}$)
- The survival of larvae decreases through generations in a high transmission group and increases in a low transmission group ($\rho = 0.011$).

The results of our study are consistent with theory. As previous studies[1] suggest such changes in larval traits may be adaptive for parasites in several ways when transmission opportunities are high:

- Decrease of larval size may allow the production of increased number of larvae and an advantage during infection;
- Decreased survival rate of larvae may not be a disadvantage when hosts are plentiful.

Thus, these assumption are to be tested in further research.
More data will be analysed and added to the research (BIO299 final report) as this is only a subset for one of three replicates.

References:
1 Mennerat A., Nilsen F., Ebert D., Skorping A. 2010. Intensive Farming: Evolutionary Implications for Parasites and Pathogens. Evol Biol 37, 59–67. https://doi.org/10.1007/s11692-010-9089-0
2 Mennerat A., Ugelvik M., & Jensen C., Skorping A. 2017. Invest more and die faster: The life history of a parasite on intensive farms. Evolutionary Applications. 10. 10.1111/eva.12488.