

Does Higher Transmission of Parasites Cause Evolution of Higher Virulence?

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Background

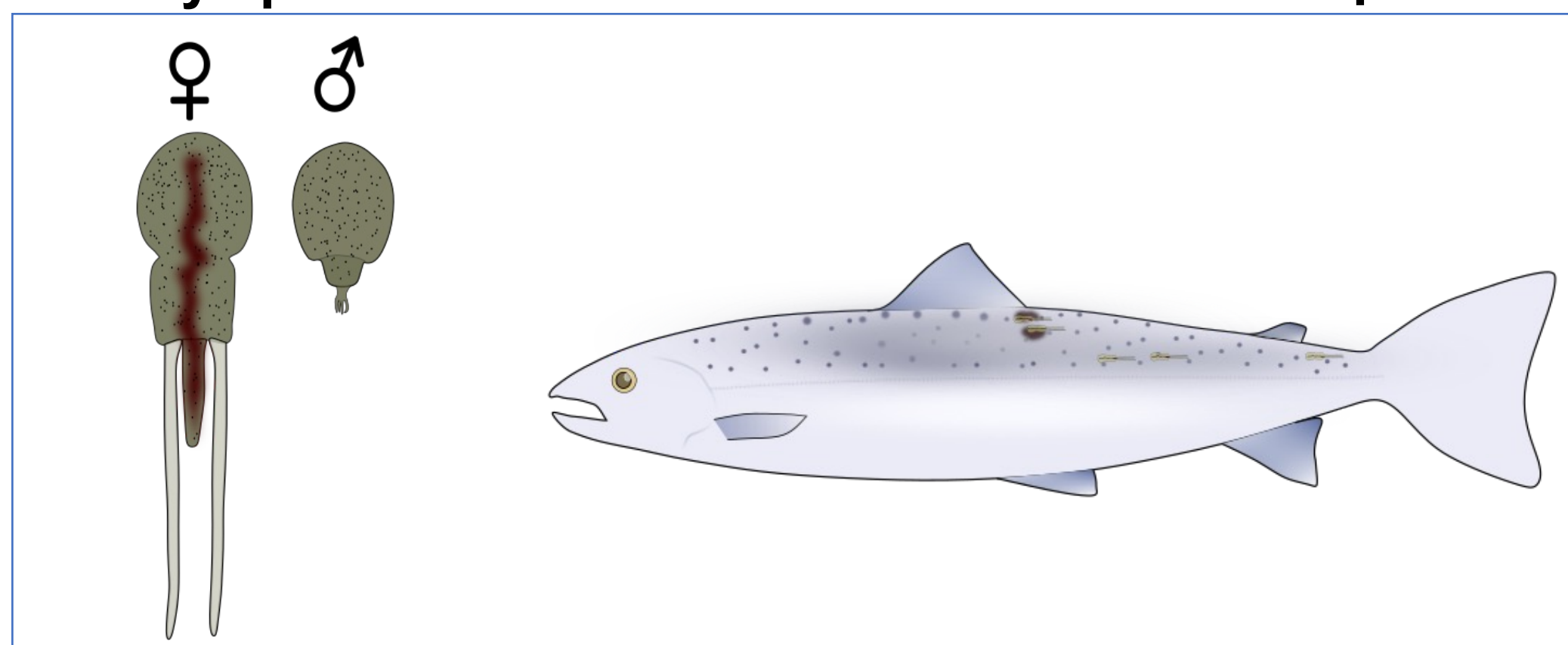
Since Norwegian fish farming began in the 1970s, it has rapidly grown and led to the development of intensive aquaculture. However, the industry has faced a growing problem in recent years: the salmon louse (*Lepeophtheirus salmonis*). These parasites feed on the skin of salmon hosts (*Salmo salar*) to grow and reproduce and can leave severe wounds.

Evolutionary theory predicts that greater opportunities for transmission of infectious organisms lead to the evolution of higher virulence - defined as the reduction in host fitness due to infection¹. Farmed salmon experience ecological conditions that are vastly different from those in the wild: they are kept in high density, are frequently culled, and they often have limited genetic variation². Therefore, salmon lice on farms experience much greater transmission than in wild salmonid populations. To test whether this leads to the evolution of higher virulence levels, three replicate populations go through two contrasting selection regimes in a laboratory experimental evolution study.

Methods

Parasite-host system

Study species



Host species

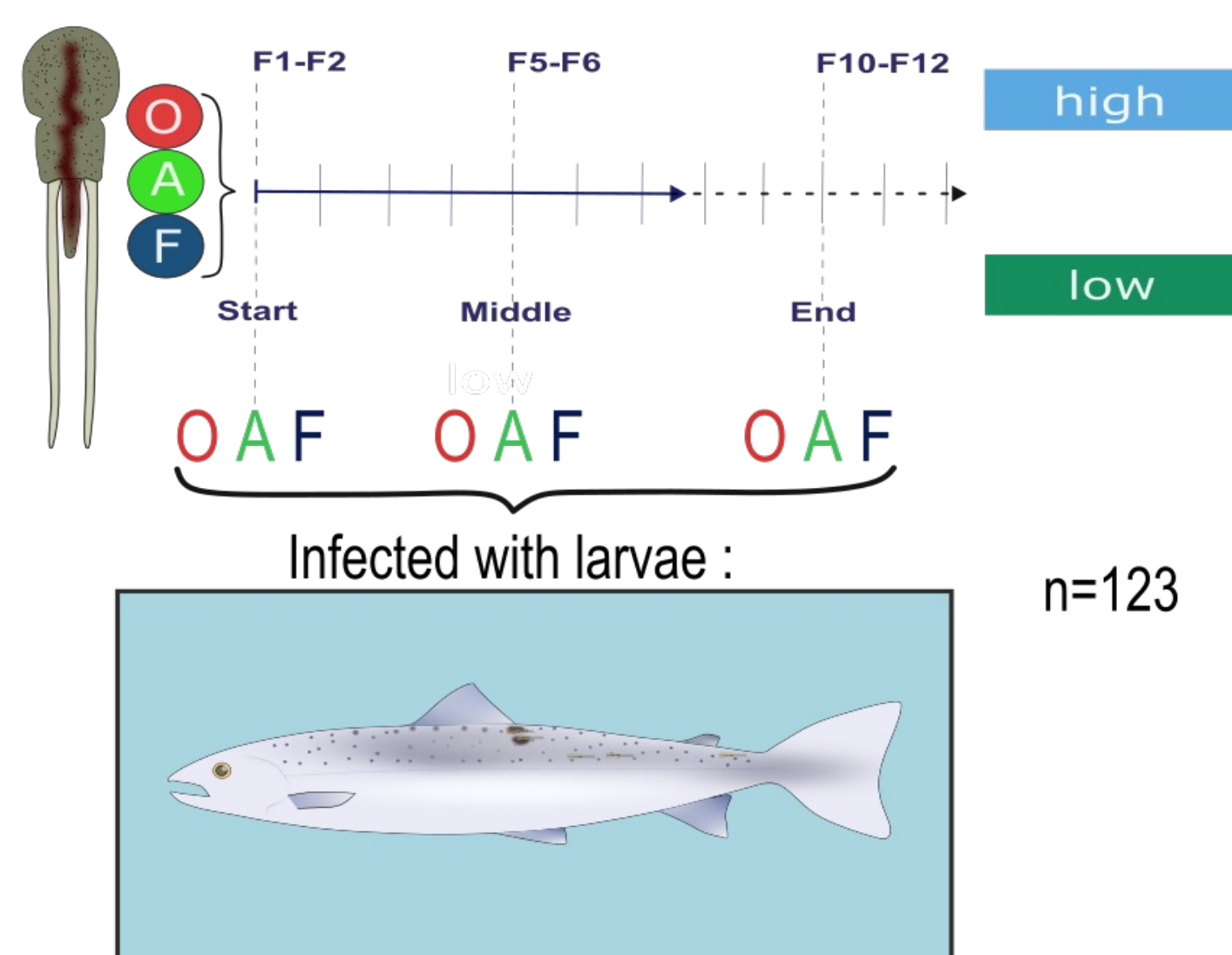
- Lice are kept on hosts under two experimental treatments:

High transmission (3 tanks)

- 15 fish
- Infection:** 30 larvae / fish in ~ 150 L water → 3 larvae / L
- Post infection:** 500 L water

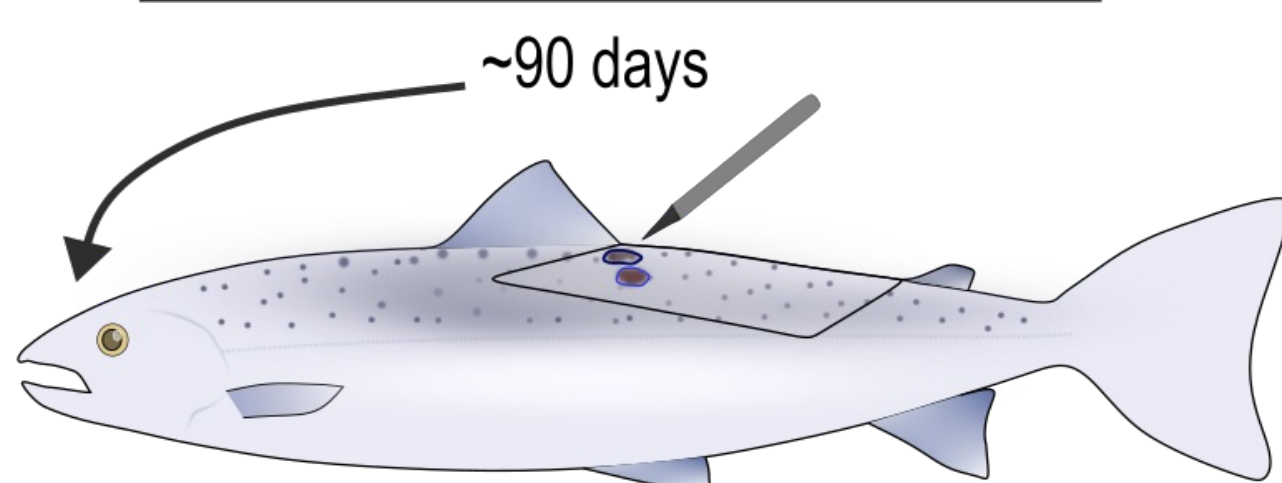
Low transmission (3 tanks)

- 5 fish
- Infection:** 15 larvae / fish in 500 L water → 0,15 larvae / L
- Post infection:** 500 L water



n=123

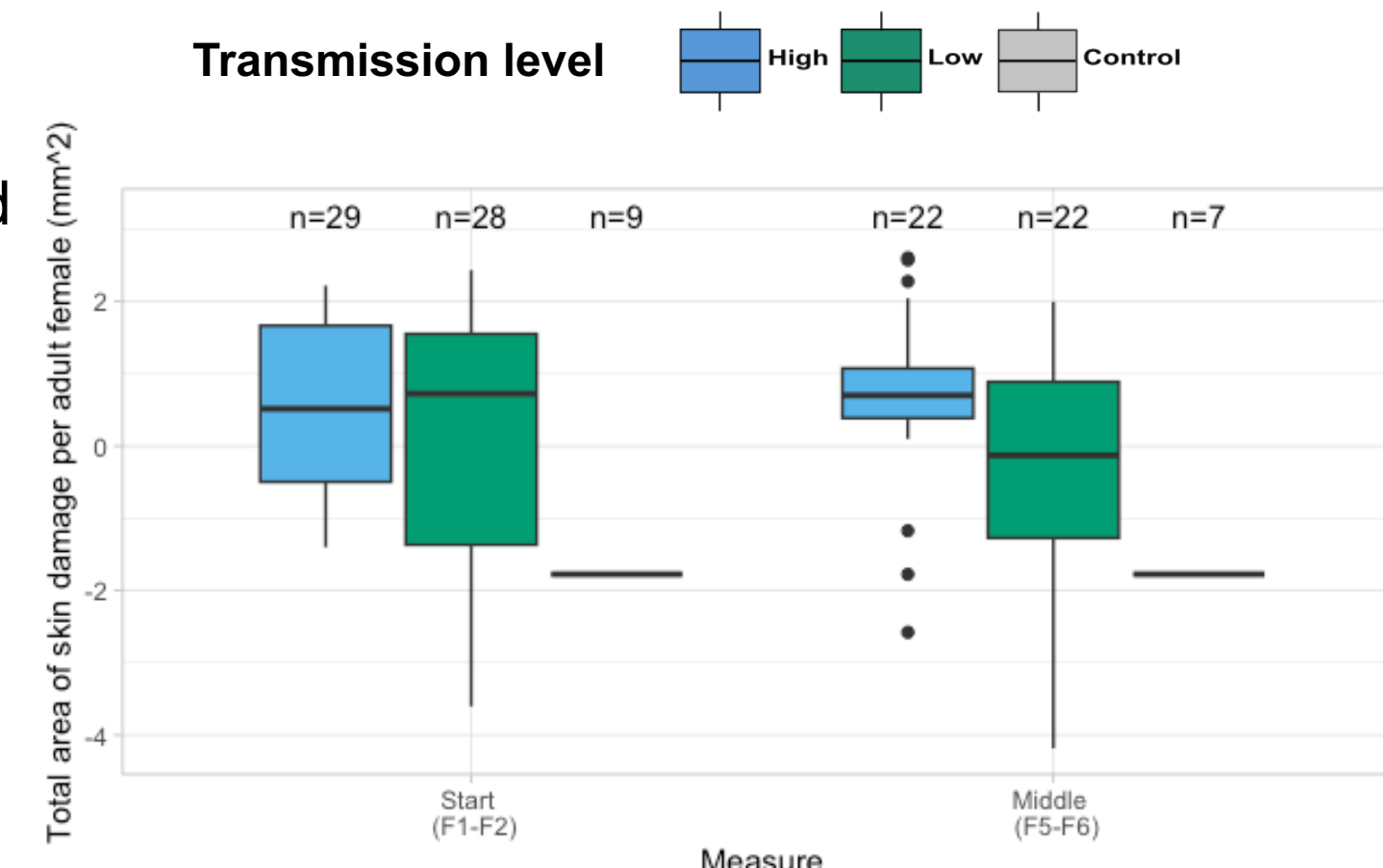
- The salmon are sedated and euthanized.
- Damage on their skin due to lice grazing is drawn on to plastic film.
- The number of parasites, weight, and length of the fish are also recorded.



Results

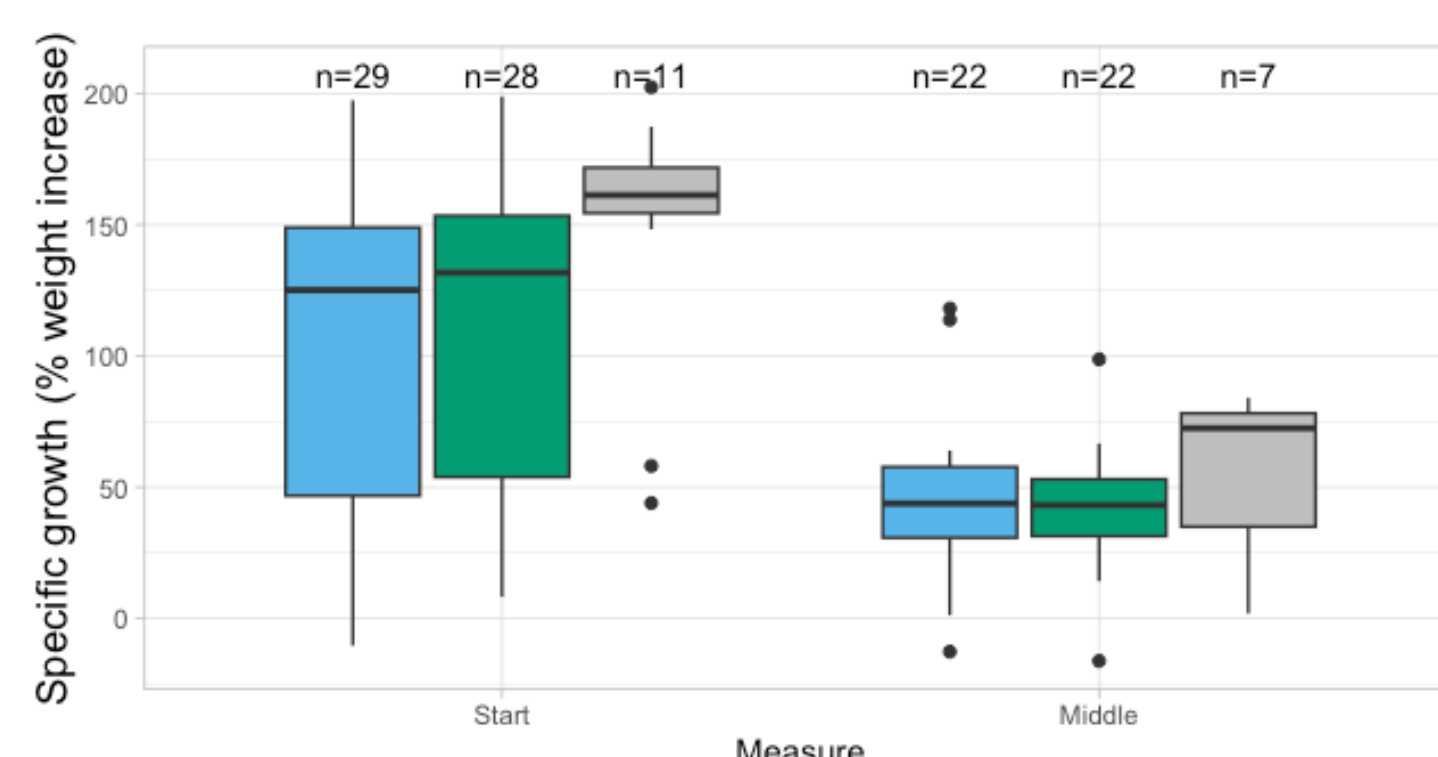
Skin damage

- The damage caused by grazing on the host's skin was greater for salmon lice evolved in the "High" than in the "Low" transmission group ($P = 0.02$).



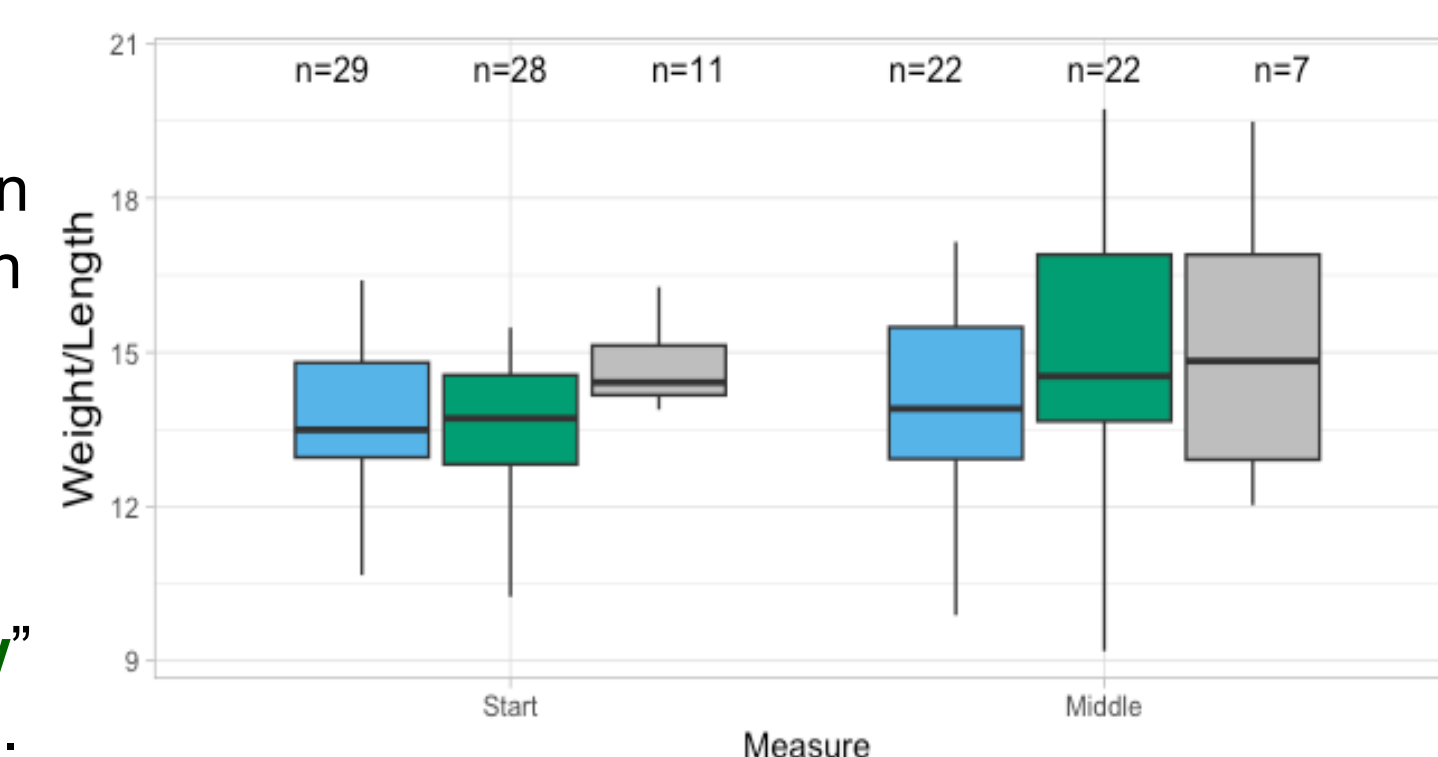
Specific growth

- Infection with salmon lice caused reduced weight gain as compared to uninfected controls ($P < 0.005$), but there was no significant difference between the "High" and "Low" transmission groups.



Body condition

- After a 90-day infection, uninfected Control hosts were in better body condition than infected hosts ($P=0.02$) but there was no significant difference between the "High" and "Low" transmission groups.



Conclusion

Lice evolved in the "High" transmission groups do seem to cause more skin damage, despite the small sample sizes - and there is also a trend for greater reduction of host growth and condition. This is consistent with differences found between lice from farmed versus wild areas, shown in the study of Ugelvik et al. (2017)³. The present study is also not completed yet, as the final measures of virulence need to be taken.

References:

- Mennerat, A., Ugelvik, M.S., Jensen, C.H., & Skorping, A. (2017). Invest more and die faster: The life history of a parasite on intensive farms. *Evolutionary Applications* 10(9): 890-896.
- Mennerat, A., Nilsen, F., Ebert, D., & Skorping, A. (2010). Intensive Farming: Evolutionary Implications for Parasites and Pathogens. *Evolutionary Biology*, 37:59-67.
- Ugelvik M.S., Skorping A., Moberg O. & Mennerat A. (2017) Evolution of virulence under intensive farming: Salmon lice increase skin lesions and reduce host growth in salmon farms. *Journal of Evolutionary Biology* 30(6):1136-1142.



SCAN ME

