

Late maturation

From nature, the salmon has developed various reproductive strategies to bring their genes to the next generation. Both early and late sexual maturation can occur based on a variety of external and internal stimuli.

Environmental factors such as light, temperature and salinity, and the fish's genetic background, nutrition and health status will individually or together affect whether the maturation process should start. Which factors have the greatest impact on the development of maturation is not clear.

Sexual maturation in food fish production

In food fish production, sexual maturation is very negative. This leads to welfare problems for the fish, reduced growth and poor fillet quality, as nutrients are prioritized for egg- and milt production.

Male fish are particularly susceptible to early maturation, in some cases long before they reach harvest size. Fish farmers often use artificial light in the sea cages to prevent sexual maturation and this works well in many cases. However, in the future, sexual maturation can become a major problem if sea water temperature increases and production of large smolt or up to harvest size in closed systems becomes more common.

QTLs for maturation

AquaGen has validated two QTLs that partially control the timing of maturation in female and male

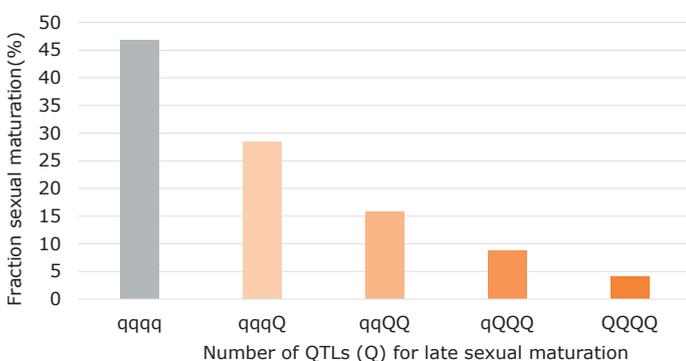


Figure 1. Fraction of mature male salmon in relation to number of favourable copies (Q) in two QTLs for late maturation. 13 309 male fish were registered for external signs of maturation and genotyped after the first winter in sea under natural light conditions (without the use of artificial light) at a site in central Norway. The fish were put to sea in the autumn of 2015 and the registrations were made 15 months after sea transfer at an average weight of 5.7 kg.

salmon. These QTLs are described both in wild Atlantic salmon populations (published in Nature 2015, volume 528, pages 405–408) and have been investigated in AquaGen's own Atlantic salmon broodstock populations:

The time of maturation of female and male salmon after the first winter in sea was recorded in 17 586 salmon. Artificial light was not used to suppress sexual maturation. DNA was analyzed for each fish, to find correlations between maturation and genetic composition (QTLs).

Good correlation between maturation of male salmon and QTLs

For the two mentioned QTLs, a good correlation was found for maturation in male salmon. The more copies of the beneficial gene variant (Q) the fish had, the smaller the proportion of the fish had external signs of maturation (Figure 1). There were few female salmon that became sexually mature at this time. Based on the results of this data material, we have selected for reduced maturation of male salmon through QTL-innova® LATEMAT (Figure 2). However, it is important to point out that factors in the environment and the fish (other than genetic) will also affect the timing and degree of maturation.

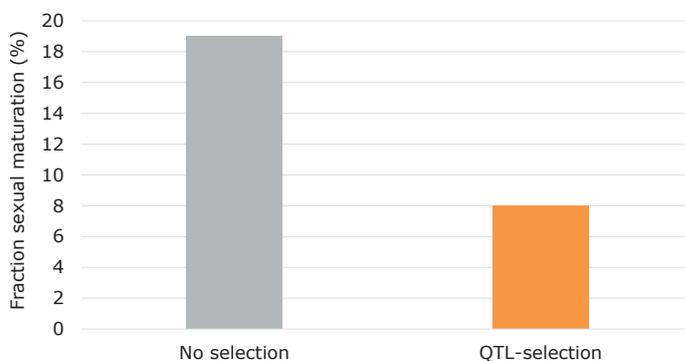


Figure 2. Estimated fraction of maturation in male salmon that is not selected (randomly selected) and QTL-selected for late maturation. The data is based on the material described in Figure 1. The number of beneficial gene variants (Q) in QTL-innova® LATEMAT is 2-4 (qqQQ-QQQQ).

Products with late maturation:

- AquaGen® Atlantic QTL-innova® LATEMAT (can be selected as an addition to other products)

Benefits of QTL-innova® LATEMAT:

- Contributes to reduced sexual maturation in male salmon