

Researchers discover size gene for salmon

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The size of returning Atlantic salmon is largely dependent on the number of years that the salmon remains at sea before returning to spawn in the river. The genetic basis of this trait has not been previously known, making the management of the impact of fishing difficult. In many Atlantic salmon populations, the sea-age at maturity, i.e. the number of years at sea, has been declining.

A joint Finnish-Norwegian-Scottish study has discovered a single gene that very strongly influences the variation in age at maturity, and therefore size, in salmon. The research results have been published in the prestigious scientific journal, *Nature*.

- The gene, *VGLL3*, regulates the accumulation of body fat, which is

critical in determining the timing of maturation. Surprisingly, this same gene is also involved in regulating the timing of puberty in humans. This research result will have profound implications for the management and protection of wild salmon populations. The result may also help research related to the timing of puberty in humans, and health issues related to late or early puberty onset, notes Academy Professor Craig Primmer from the University of Turku, Finland.

Gene Regulates Age at Maturity Differently for Males and Females

By looking at how this one gene influences age at maturity in males and females separately, the research group discovered an important, but previously unobserved, type of genetic determination that helps to balance out differing interests of sexes. Males and females share the same genome which constrains the evolution of some traits when natural selection acts in different directions in the two sexes. One example of this is aggressiveness, which can be beneficial for males, but unfavourable for females.

- Such evolutionary "tug-of-wars" between the sexes are very common, and can result in neither sex being able to obtain the optimum trait value. This can even lead to an elevated extinction risk for populations. The genetic control in one sex must somehow become separated from that in the other, which is a tricky feat when a single gene has such a large effect, says Dr. Tutku Aykanat, one of the lead authors in the study.

The longer both male and female salmon stay at sea, the bigger they are prior to spawning and the more offspring they will have. However, this also increases the risk that the salmon will die before being able to reproduce at all.

- The optimal outcome to solve this dilemma is different for males and females. Male salmon benefit from maturing younger and smaller, while females gain from maturing older and larger, Aykanat continued.

This conflict between the sexes is resolved if the same gene regulates the age of maturity optimally, i.e. differently, for the different sexes.

Although this phenomenon plays an important role in theoretical models of evolution, this type of genetic control had never been observed in real life before. The researchers found this type of control in Atlantic salmon.

- Our results can be utilised in the management and protection of salmon populations. The 'large salmon gene' could be used to reintroduce individuals more likely to mature later into populations where large salmon once occurred, says Research Professor Jaakko Erkinaro from the Natural Resources Institute Finland.

- Since different forms of the gene are favoured in males and females, [natural selection](#) favours both forms being maintained in the population. This leads to the variation in age at maturity being maintained, which promotes the stability and resilience of Atlantic salmon populations. The research results will have profound effects on the possibility of preserving the age and size of maturity of [salmon populations](#), adds Erkinaro.

The results will also have significant impacts on ecology and evolution research more generally.

More information: Nicola J. Barson et al. Sex-dependent dominance at a single locus maintains variation in age at maturity in salmon, *Nature* (2015). [DOI: 10.1038/nature16062](https://doi.org/10.1038/nature16062)

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