**Supplementary material:**

**Life-history genotype explains variation in migration activity in Atlantic salmon (*Salmo salar*).**

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**Supplementary Table 1.** Parameter estimates for additive and dominance models for downstream acitivity when body condition is added as a covariate in the migrant fish model. We present fixed parameter estimates (i.e. β) with standard error (i.e. SE) and *P*-values and, random parameter estimates (i.e. standard deviation = σ) with 95% credible intervals (i.e. CI). Genotypes modeled as: *vgll3*\*EE = 1, *vgll3*\*EL = 0, *vgll3*\*LL = -1. Condition was defined as the residuals from the model: weight~length+lenth2 (weight and length were measured directly after the experimental period: see methods for more detail).

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| --- | --- | --- |
| **Migratory phenotype** | *Downstream* |  |
| **Fixed effects** | β (SE) | *P* |
| Intercept | 2.435 (0.319) | >0.001 |
| vgll3\_ADDITIVE | 0.074 (0.035) | 0.036 |
| Sex1 | -0.001 (0.047) | 0.989 |
| vgll3\_DOMINANCE | 0.086 (0.058) | 0.139 |
| Condition | -0.049 (0.0220) | 0.027 |
| vgll3\_ADDITIVE:Sex1 | -0.113 (0.047) | 0.016 |
| vgll3\_DOMINANCE:Sex1 | -0.077 (0.162) | 0.346 |
| Condition:Sex1 | -0.068 (0.030) | 0.024 |
| **Random Effects** | σ (95% CI) |   |
| Individual | 0.407 (0.380, 0.436) |   |
| Date | 1.574 (1.227, 2.020) |   |
| Pool | 0.297 (0.198, 0.447) |   |
| Cross | 0.212 (0.090, 0.500) |   |
| Mother | 0.025 (<0.001, >10.00) |   |
| Father | 0.122 (0.063, 0.234) |   |
| Hour | 0.266 (0.199, 0.355) |   |
| 1 Reference sex is Female |   |   |

**Supplementary Table 2.** Data scale predictions and hourly distance moved in meters for *vgll3* and sex effects on activity. Predictions are extracted from models presented in Table 1. The conversion to meters was done by multiplying the activity estimates by 6.54, i.e. the distance between two adjacent antennae at the center of the pool.

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| --- | --- | --- |
|  | **FEMALE** | **MALE** |
|   | ***Upstream activity (SE)*** | ***Meters/hour*** | ***Upstream activity (SE)*** | ***Meters/hour*** |
| **Migrant fish** |   |   |   |   |
| LL | 1.89 (0.58) | 12.3 | 1.96 (0.61) | 12.8 |
| EL | 1.98 (0.61) | 13.0 | 1.85 (0.57) | 12.1 |
| EE | 2.08 (0.64) | 13.6 | 1.74 (0.54) | 11.4 |
| **Non-migrant fish** |  |  |  |  |
| LL | 0.44 (0.11) | 2.9 | 0.36 (0.09) | 2.3 |
| EL | 0.41 (0.10) | 2.7 | 0.37 (0.09) | 2.4 |
| EE | 0.39 (0.09) | 2.5 | 0.38 (0.09) | 2.5 |
|   | ***Downstream activity (SE)*** | ***Meters/hour*** | ***Downstream activity (SE)*** | ***Meters/hour*** |
| **Migrant fish** |   |   |   |   |
| LL | 11.24 (3.58) | 73.5 | 12.02 (3.83) | 78.6 |
| EL | 12.00 (3.80) | 78.5 | 11.26 (3.56) | 73.6 |
| EE | 12.80 (4.08) | 83.7 | 10.54 (3.36) | 68.9 |
| **Non-migrant fish** |  |  |  |  |
| LL | 1.94 (0.46) | 12.7 | 1.59 (0.37) | 10.4 |
| EL | 1.85 (0.42) | 12.1 | 1.67 (0.38) | 10.9 |
| EE | 1.77 (0.42) | 11.6 | 1.76 (0.41) | 11.5 |
|   | ***Total activity (SE)*** | ***Meters/hour*** | ***Total activity (SE)*** | ***Meters/hour*** |
| **Migrant fish** |   |   |   |   |
| LL | 15.57 (4.79) | 101.8 | 16.59 (5.09) | 108.5 |
| EL | 16.61 (5.07) | 108.6 | 15.52 (4.74) | 101.5 |
| EE | 17.71 (5.45) | 115.8 | 14.52 (4.46) | 95.0 |
| **Non-migrant fish** |  |  |  |  |
| LL | 3.10 (0.69) | 20.2 | 2.53 (0.56) | 16.6 |
| EL | 2.95 (0.63) | 19.3 | 2.66 (0.56) | 17.4 |
| EE | 2.81 (0.62) | 18.4 | 2.80 (0.61) | 18.3 |
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**Supplementary Table 3.** Parameter estimates for a model where a *vgll3*-dateinteraction is fitted as a random effect for the model presented in Table 1. We present fixed parameter estimates (i.e. β) standard errors (i.e. SE) and P-values. As the results were qualitatively the same across all three behaviours, we present here only the estimates for downstream activity.

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| --- | --- | --- |
| **Migratory fish** | *Downstream activity* |  |
| **Fixed effects** | β (SE) | *P* |
| Intercept | 2.447 (0.317) | <0.001 |
| *vgll3*\_ADDITIVE | 0.087 (0.038) | 0.022 |
| Sex1 | -0.022 (0.049) | 0.647 |
| *vgll3*\_DOMINANCE | 0.111 (0.060) | 0.063 |
| *vgll3*\_ADDITIVE:Sex1 | -0.133 (0.048) | 0.006 |
| *vgll3*\_DOMINANCE:Sex1 | -0.126 (0.085) | 0.136 |
| **Random Effects** | σ  |  r |
| Individual | 0.424 |   |
| Date | 1.574 |   |
| *vgll3\_ADDITIVE* | 0.054 | -0.61  |
| Stream | 0.290 |   |
| Crossing group | 0.202 |   |
| Mother | 0.054 |   |
| Father | 0.106 |   |
| Hour | 0.266 |   |
| 1 Reference sex is Female |   |   |

**Supplementary Table 4.** Parameter estimates for additive and dominance models for upstream and downstream movement for migrants when date and hour are added as covariates. We present fixed parameter estimates (i.e. β) with standard error (i.e. SE) and *P*-values and, random parameter estimates (i.e. standard deviation = σ) with 95% credible intervals (i.e. CI). Genotypes modeled as: *vgll3*\*EE = 1, *vgll3*\*EL = 0, *vgll3*\*LL = -1.

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| --- | --- | --- | --- | --- |
| **Migrant fish** | *Upstream* |  | *Downstream* |  |
| **Fixed effects** | β (SE) | *P* | β (SE) | *P* |
| Intercept | 0.055 (0.112) | 0.623 | 1.502 (0.134) | <0.001 |
| vgll3\_ADDITIVE | 0.059 (0.029) | 0.042 | 0.074 (0.037) | 0.047 |
| Date | 0.075 (<0.001) | <0.001 | 0.090 (<0.001) | <0.001 |
| Hour | 0.008 (<0.001) | <0.001 | 0.010 (<0.001) | <0.001 |
| Sex1 | -0.027 (0.039) | 0.497 | -0.008 (0.050) | 0.880 |
| vgll3\_DOMINANCE | 0.072 (0.048) | 0.134 | 0.106 (0.061) | 0.082 |
| vgll3\_ADDITIVE:Sex1 | -0.119 (0.039) | 0.002 | -0.140 (0.049) | 0.005 |
| vgll3\_DOMINANCE:Sex1 | -0.091 (0.068) | 0.181 | -0.138 (0.086) | 0.110 |
| **Random Effects** | σ (95% CI) |   | σ (95% CI) |   |
| Individual | 0.335 (0.312, 0.360) |   | 0.428 (0.400, 0.459) |   |
| Stream | 0.284 (0.195, 0.415) |   | 0.325 (0.220, 0.479) |   |
| Cross | 0.151 (0.066, 0.342) |   | 0.185 (0.081, 0.422) |   |
| Mother | 0.054 (0.016, 0.179) |   | 0.063 (0.017, 0.233) |   |
| Father | 0.089 (0.041, 0.194) |   | 0.122 (0.062, 0.242) |   |

**Supplementary Table 5.** Parameter estimates for *vgll3* and sex effects on onset of migration. We present fixed parameter estimates (i.e. β) standard errors (i.e. SE) and P-values. Onset of migration was defined as date when the downstream movement reached 120 stream rounds day-1 (i.e. 5 rounds hour-1) among migrant fish (see methods).

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|  | *Onset of migration* |  |
| **Fixed effects** | β (SE) | *P* |
| Intercept | 15.092 (0.143) | <0.001 |
| *vgll3*\_ADDITIVE | -0.006 (0.178) | 0.971 |
| Sex1 | -0.353 (0.198) | 0.076 |
| *vgll3*\_ADDITIVE:Sex1 | -0.208(0.243) | 0.391 |
| 1 Reference sex is female |   |   |

**Supplementary Figure 1.** Photos of the ring-shaped experimental streams. Fish did not have access to the center pool in the middle of each ring-shaped stream, i.e. fish only occupied the outer ring of the stream. The picture at the bottom captures one of the four RFID-antennas in a stream covering the bottom, sides and top of the water bed in the stream. Photo credits: Ines Klemme.

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**Supplementary Figure 2.** Best linear unbiased predictors (i.e. BLUPs) for downstream activity for each date. BLUPs are presented separately for migrant (i.e. smolt) and non-migrant (i.e. parr) fish. BLUPs for each date are extracted from models presented in Table 1. As the results were qualitatively the same across all three behaviours, we present here only the BLUPs for downstream activity.



**Supplementary Figure 3.** Linear predictions for sex-specific effects of body condition on recorded activity. Shaded areas represent standard errors around the predictions. The predictions are derived from model estimates presented in Supplementary Table 1. As the results were qualitatively the same across all three behaviours, we present here only the predictions for downstream activity. Condition (X-axis) was defined as the residuals from the model: weight~length+lenth2 (weight and length were measured directly after the experimental period: see methods for more detail). In the X-axis, negative values refer to lower condition while positive values refer to higher condition.



**Supplementary Figure 4.** Linear prediction for the effect of *vgll3* genotype on condition among migrants. The shaded area represent standard errors around the prediction. The predictions are calculated from estimates delivered by a model: condition ~ *vgll3*\_additive + Sex + (1|Stream) + (1|mother) + (1|father). Other random effects, as present in the main models, were omitted since only one condition measurement per individual was obtained (thus among-individual, date and hour variation are not present). In the Y-axis, negative values refer to lower condition while positive values refer to higher condition. Condition was defined as the residuals from the model: weight~length+lenth2 (weight and length were measured directly after the experimental period: see methods for more detail).

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