Stress-resilience differences related to emergence time in farmed rainbow trout

Manuel Gesto, Alfred Jokumsen

Section for Aquaculture, DTU Aqua
Technical University of Denmark
Swim-up behavior and Emergence time

Individual variation in time from emergence in salmonid fishes.

Has emergence time any effect on fish robustness?? Any effect on stress resilience?
Previous data

Wild fish with different emergence time seem to have different SCS and competitive ability. Fish emerging early have been shown to be more aggressive, prone to be dominant, proactive.

Farmed fish??
Hypothesis

*Does farmed fish sorted by emergence time differ in how they respond and resist against punctual and repeated stressors?*
Selecting fish by emergence time: Sorting device

Three swim-up fractions:
- Early 20%
- Medium 20%
- Late 20%

Stress resilience

Vaz-Serrano et al., 2011
Mortality after sorting

Cumulative mortality (%)
Mortality after sorting

![Cumulative mortality (/tank) at day 20](image)
Stress resilience test – Exp. Design

5 g fish

Daily stress (air exposure) 14 days

Acute stress

Sampling points: 0, 1, 2, 4, 8 h.

Brains and blood
Stress resilience test – samples

Stress markers analyzed:

- Fish length/weight – condition factor
- Plasma cortisol
- Plasma glucose and lactate
- Brain serotonergic activity

Data provided information about:

- Normal acute stress response in each fraction
- Effects of repeated stress on the normal acute stress response - Resilience
Data – Fish size

Fish size and condition factor – Among Fractions  \( n = 150 \)
Stress resilience data - Cortisol

Response to acute stress in control fish
Stress resilience data - Cortisol

Response to acute stress in repeatedly stressed fish
Stress resilience data — Brain serotonergic activity

- **Early**
  - Control
  - Repeated stress

- **Medium**
  - Control
  - Repeated stress

- **Late**
  - Control
  - Repeated stress

Serotonergic activity (% 5HIAA/5HT) vs. Time after exposure (min)
Restrictive feeding – competition tests

Has emergence time any effect on juvenile growth or on juvenile competitive ability for food?

Fish (~60 g) from the three different fractions were PIT-tagged and held together in the same tanks.

3 tanks containing 15 fish of every fraction (45 fish /tank) each.

Growth of the fish was then evaluated under different feeding regimes.
Restrictive feeding – competition exp.
Competition and growth

After 15 days under normal feeding (~2% body mass/day):

![Average mass gain (%)](image1)

![Average Fork Length gain (%)](image2)

After 10 days of fasting:

![Average mass loss (%)](image3)
Restrictive feeding – competition exp. 
Competition and growth

Next step:
Stocking density reduced: 15 fish per tank (5 fish of each fraction, size-paired)

After 7 days at low density with restrictive feeding (0.5% body mass/day):

![Graphs showing average mass gain and average fork length gain.](image)
Conclusions

Acute stress response and stress resilience are different in fish from different emerging fractions.

Early fraction apparently has a higher capacity to habituate to mild stressors, i.e. more resilient.

No relationship has been found between emergence time and fish growth or fish competitive ability.

Performance of farmed trout related to emergence time seem to be highly influenced by fish origin/genetic background.
Acknowledgements

Jonas Müller – Christian Albrechts Universität zu Kiel

Present and former members of RobustFish project: Peter V Skov, Ivar Lund, Lars-Flemming Pedersen, Erik Höglund.

Our technicians: Ole Madvig Larsen, Rasmus Frydenlund Jensen

RobustFish is part of the Organic RDD 2 programme, which is coordinated by International Centre for Research in Organic Food Systems (ICROFS).

It has received grants from the Green Growth and Development programme (GUDP) under the Danish Ministry of Food, Agriculture and Fisheries.
Stress resilience data - Glucose

Early

Medium

Late

Time after exposure (min)
Stress resilience data - Lactate

- Early
- Medium
- Late

Control vs. repeated stress

Plasma lactate (mM) vs. time after exposure (min)
Data – Fish size

Fish size and condition factor – Control vs Repeated stress  \( n=225 \)

- **Body mass (g)**: *P=0.006*
- **Fork length (cm)**: *P=0.005*
- **Condition factor**
Restrictive feeding – competition exp.  
Competition and growth

At low density and with restrictive feeding, fish **truly compete for food.**

Any relationship between dominance and emergence fraction?  
*Apparently not*