Random regression analysis of feed efficiency in families of Turbot

Wendy Rauw*, Antti Kause○, Santiago Cabaleiroφ, Rubén Caamañoφ, Luis Alberto García*, Luis Gomez Raya*

*INIA Madrid  ○Natural Resources Institute Finland  φCluster de la Acuicultura de Galicia
Introduction

Feed efficiency:

Feed > 50% of production costs & environmental loading

Feed Conversion Ratio (FCR) vs Residual Feed Intake (RFI)

Measurement of (individual) feed intake
In livestock species: cattle, pigs, chickens, etc
Introduction

Feed efficiency in fish:

- Measurement of (individual) feed intake complicated
  - Housing fish individually
  - X-radiography

- Using the tank as the unit of measurement
Material & Methods

1. Feed efficiency during growth
2. Feed efficiency with restricted feeding
3. Feed efficiency, growth and slaughter
Material & Methods

Feed efficiency during growth

2. Feed efficiency with restricted feeding
3. Feed efficiency, growth and slaughter
Material & Methods

Facilities:
Cluster de Acuicultura de Galicia (CETGA)

1 room
8 families
84 fullsibs/family
3 tanks/family

400L, open-circuit seawater, ~13.6°C
Material & Methods

Trait recording

Individual body weight (BW) at 0, 47, 83, 119 days exp.

Feed intake per tank
Period 1: 0 – 47
Period 2: 47 – 83
Period 3: 83 – 119
Material & Methods

Trait recording

Individual body weight (BW) adjusted to age

• Coefficient of variation in BW = \([sd/mean] \times 100\%\)
Material & Methods

Trait recording

On tank-average values:

Feed conversion ratio (FCR) = FI / BWG

Residual feed intake (RFI) =

\[ Fl_i = b_0 + (b_1 \times BW_i^{0.80}) + (b_2 \times BWG_i) + e_i \]
Material & Methods

Statistical analysis

Few, repeated observations:
Random regression (R 2.6.2) with Bayesian interference

Lmer \{y \sim 1 + \text{Period} + [1 + \text{Period} | \text{Tank:Family}]\}

Fixed

Random

1 = intercept = baseline measure (centered data)
Period = slope = rate of change

→ Overall effect, tank effect, family effect
Results

Body weight gain

Fixed:
Intercept = significant
Slope = significant

Random Family:
Intercept = significant (P < 0.001)
Slope = not significant
Results

Residual feed intake

71% of FI explained by BWG and BW$^{0.80}$
Results

Residual feed intake

Fixed:
Intercept = not significant
Slope = not significant

Random Family:
Intercept = not significant but ...
Slope = not significant
Results

Feed conversion ratio

Fixed:
Intercept = significant
Slope = not significant

Random Family:
Intercept = significant (P < 0.009)
Slope = not significant

FCR with RFI: $r = 0.91$
~ 15% of variation due to family
Results

Coefficient of variation

Fixed:
Intercept = significant
Slope = not significant
(but tends to decrease)

Random Family:
Intercept and slope correlated
Significant family effect (P < 0.004)

Not related to BWG or Feed efficiency
Conclusions

Feed intake and feed efficiency can be measured by tank (in trout: Rauw et al., 2016, Gomez Raya et al., in prep)

Feed efficiency of Rainbow trout (Onchorhynchus mykiss) kept at high and low stocking density

Feed Efficiency in Individual versus in Group Housed Juvenile Rainbow Trout
Conclusions

Tank measurements can be useful for selecting families that have superior feed efficiency even though within-group information is lost

→ In combination with individually recorded traits

RFI not correlated with BWG and size (FCR is)

Scarce literature: feed efficiency is heritable

→ More information needed on genetic parameters
Conclusions

Tank dynamics: traits depend on ‘self’ and tank-mates
→ Dominance hierarchy

Higher ranked = higher FI, higher BWG, increased CVbw

This study: > 60% of variation (intercept) CVbw due to family effect, may potentially have a genetic component
→ Not related to BWG or FE
→ Social behaviour? Separate tests needed
→ Relatedness?
Acknowledgements
Thanks!