# Effects of group mate relatedness on body weight and variability of body weight in Nile tilapia

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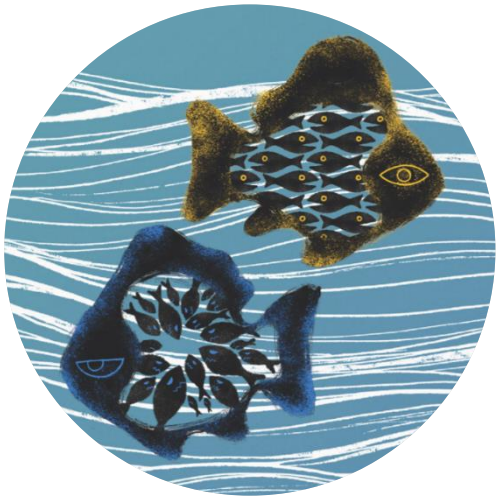
EAAP 2019



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# Acknowledgement






# Social interactions

Related

http://www.scienceagogo.com/news/20130802192045data_trunc_sys.shtml

Cooperation

Unrelated

https://www.expeditionsalaska.com/trip/photo-tour/grizzlies-in-the-fall/

Competition

- Relatives tend to share genes
- Increase evolutionary success of individuals' own genes
- Indirect fitness benefit
- Addition to direct fitness
- Inclusive fitness > kin selection
- Distinguishing between kin and non-kin > **kin recognition**

# Kin recognition in fish

- Sibling-sibling and parent-offspring
- Visual and chemosensory cues

- Atlantic cod, coho salmon, zebra fish...all show kin-biased behaviour
- Asymmetry in behaviour such as shoaling and aggressiveness

# Relevant traits in aquaculture

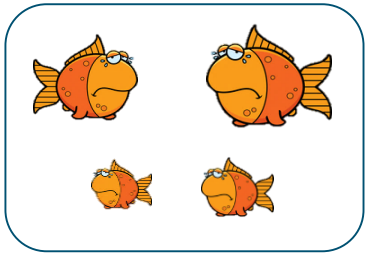
- **Competition has a negative effects**
  - Growth
  - Uniformity of trait values
  - Survival

Reduce competition

Utilize the consequence of past kin selection

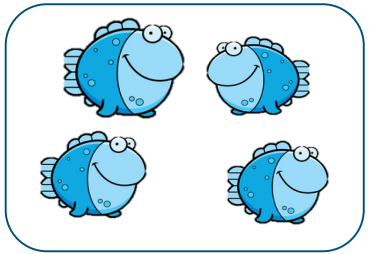
**Evolution of kin discrimination**

**Competition**



**variability**

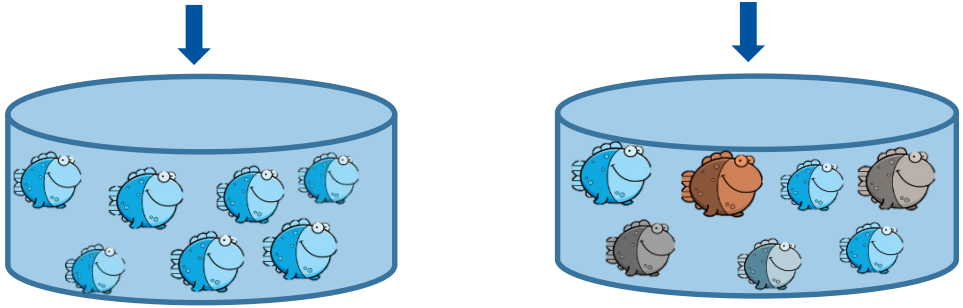
**Cooperation**



**uniformity**

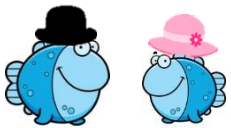
# Objective

- Investigate the effect of relatedness in Nile tilapa on
  - Body weight at harvest
  - Uniformity of body weight
  - Survival
- Two treatments: rearing in kin groups vs rearing in non-kin groups



# Experimental design

- WorldFish
- GIFT (Genetically Improved Farmed Tilapia)
- Two batches



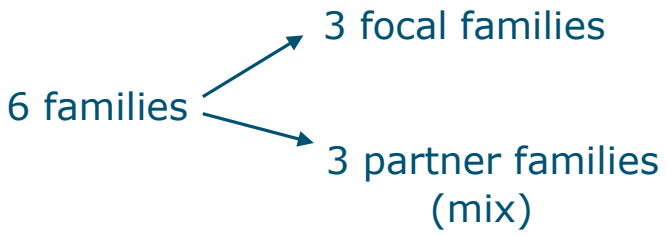
6 (unrelated) full-sib families per batch

- Fry of each family > separate nursery hapas
- Fiberglass tank > exposure to kin and non-kin chemical cues
- Tagged fish > experimental tank (4 months grow-out period)

# Experimental design

Overview of the experimental design for one batch

| | | Treatment 1 - Kin | | | Treatment 2 – Non-kin | | |
|---|---|---|---|---|---|---|---|
| | | Focal fish | | | Focal fish + Partner fish | | |
| Replicate | R1 | F1 | F2 | F3 | F1 + mix | F2 + mix | F3 + mix |
| | R2 | F1 | F2 | F3 | F1 + mix | F2 + mix | F3 + mix |
| | R3 | F1 | F2 | F3 | F1 + mix | F2 + mix | F3 + mix |
| | R4 | F1 | F2 | F3 | F1 + mix | F2 + mix | F3 + mix |
| | R5 | F1 | F2 | F3 | F1 + mix | F2 + mix | F3 + mix |




- 30 tanks, 15 per treatment
- 50 individuals in the tank
- ~1100 individuals at harvest

x2 batches

# Traits

- Body weight at individual level (2200 observations)
- Uniformity of body weight
- Survival

} Tank level (60 observations)

- Uniformity as SD (σ) and coefficient of variation $\mathrm{CV} = \frac{\sigma}{\mu} * 100\%$
- Survival $\frac{n_h}{n_s} * 100\%$

# Models

## Individual body weight

$$y_{ijklmnopq} = \mu + days_i + days_i^2 + IW_j + (oxygen \times batch)_{kl} + sex_m + treatment_n + family_o + tank_p + (row \times batch)_{ql} + e_{ijklmnopq}$$

## SD and CV

$$y_{ijkl} = \mu + AIW_i + treatment_j + family_k + e_{ijkl}$$

## Survival

$$y_{ijk} = \mu + treatment_i + family_j + e_{ijk}$$

# Results – data summary

| Trait | Kin treatment focal families | | Non-kin treatment focal families | | Non-kin treatment partner families | |
|---|---|---|---|---|---|---|
| | μ | σ | μ | σ | μ | σ |
| **Body weight (g)** | 46.3 | 22.7 | 38.1 | 18.3 | 52.8 | 22.3 |
| **SD (g)** | 18.4 | 7.0 | 14.8 | 5.6 | 19.3 | 7.1 |
| **CV (%)** | 37.1 | 6.9 | 37.2 | 9.0 | 35.2 | 7.2 |
| **Survival (%)** | 71.6 | 16.6 | 72.4 | 13.3 | 78.5 | 11.1 |

# Results – significance and effect of treatment

| Trait | Focal families kin vs non-kin treatment | |
|---|---|---|
| | p-value | Effect (SE) |
| Body weight (g) | 0.003 | 8.6 (2.6) |
| SD (g) | 0.001 | 9.9 (2.8) |
| CV (%) | 0.863 | 0.3 (1.8) |
| Survival (%) | 0.772 | -1.4 (4.0) |

# Results – treatment effect males vs. females

- Split dataset in two based on sex
- Males were 12.4g (±3.8g, p=0.003) heavier in kin treatment
- Females were 7g (±3.4g, p=0.04) heavier in kin treatment

- Average BW males 53.1g
- Average BW females 42.1g
- Relative effect of kin treatment = treatment effect/average BW
- **23.4%** for males, **16.6%** for females

# Conclusions

- Individuals had significantly higher body weight in groups composed of kin
- Nile tilapia may exhibit kin-biased behavior
- Males benefited more from kin treatment
- No difference in variability of body weight and survival between both treatments
- Aquaculture farming may benefit in yield by rearing individuals in groups composed of relatives