DETECTING GENETIC VARIANCE OF SOCIAL EFFECTS IN AQUACULTURE TRIALS WITH ARCTIC CHARR

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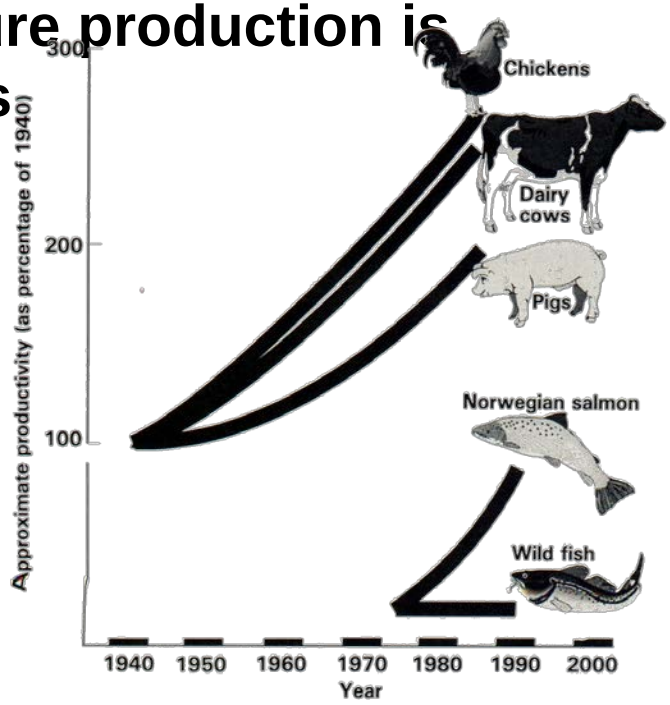
DALHOUSIE UNIVERSITY
Inspiring Minds

BACKGROUND

- **Aquaculture production has seen a tremendous increase in the past decades worldwide**
- **Nearly all this production increase has be achieved without the benefits of genetic improvement programs**
- **The immense majority of aquaculture production is based on wild or nearly wild strains**
- **The same sort of genetic improvement that has been seen in terrestrial systems could be applied to aquaculture species**

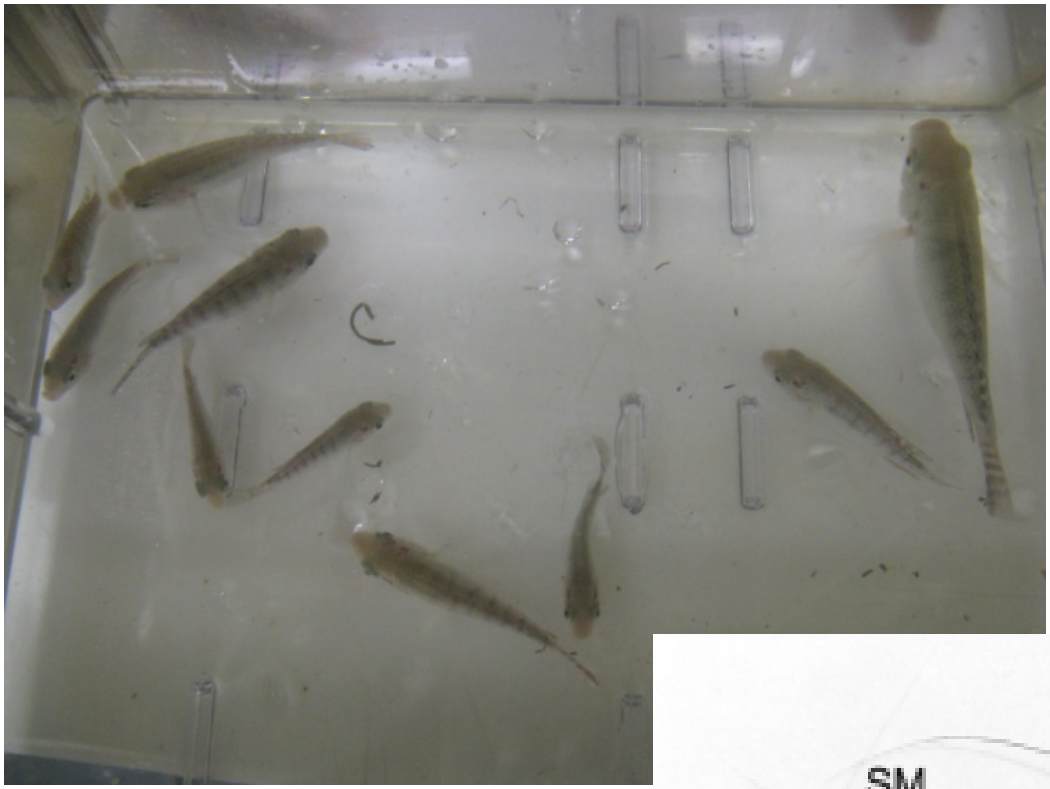


AQUACULTURE BREEDING PROGRAMS WHY THE LAG?

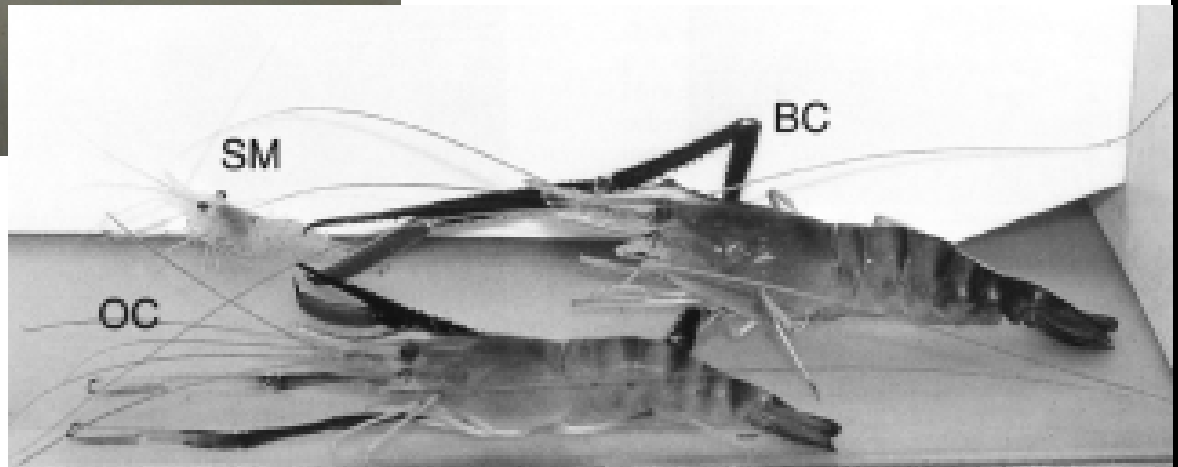
- **Very difficult to maintain pedigreed aquatic populations**
- **Aquaculture data are ‘messy’**
- **What about social interactions?**

- **Social interactions among individuals affect traits**
- **Social interactions may have a genetic basis.**
- **Selection ignoring social effects may not be optimum**

SOCIAL INTERACTIONS IN AQUACULTURE



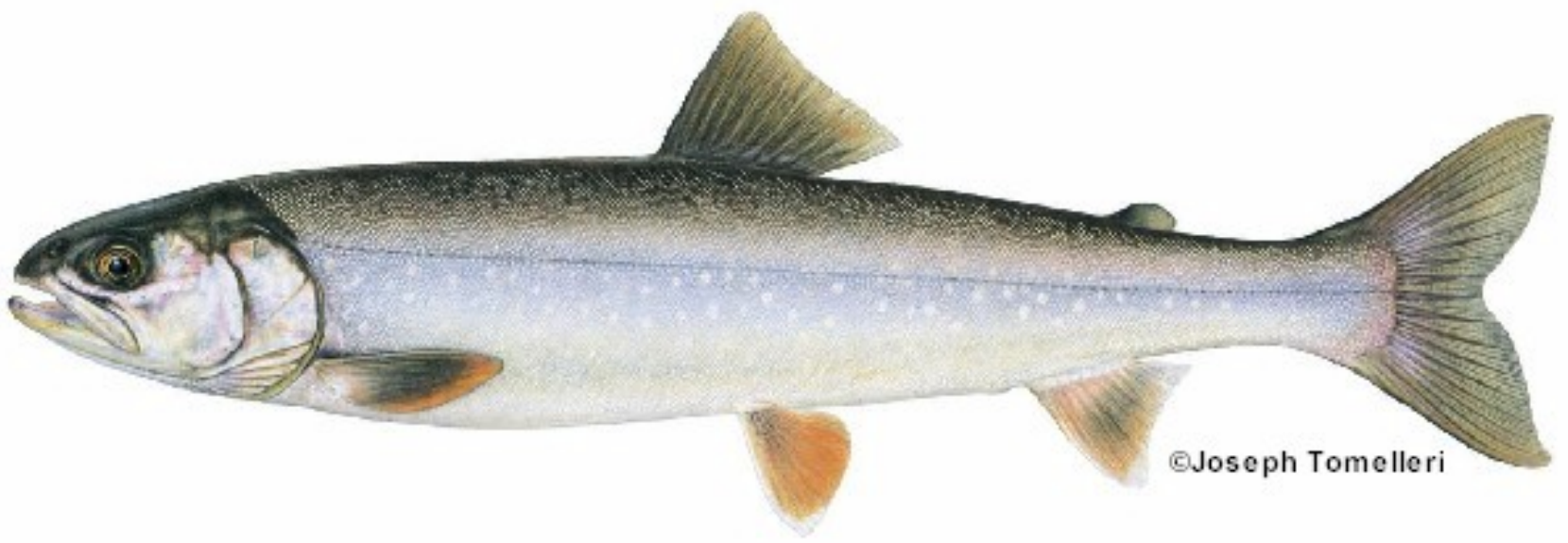
‘Shooter’ Tilapia



Dominant Shrimp

ARCTIC CHARR IN CANADA

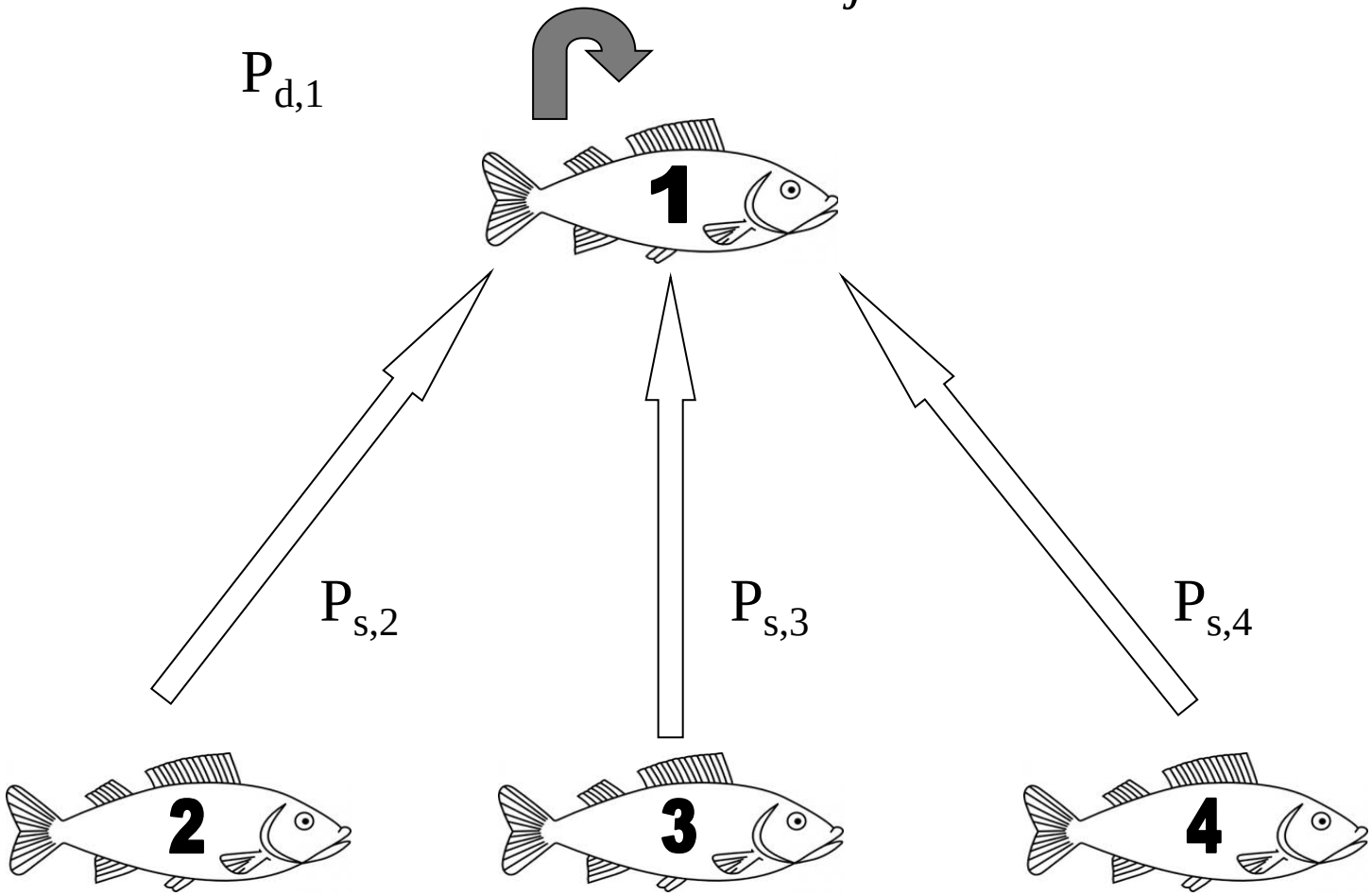
- **Arctic Charr (*Salvelinus alpinus*) has been selected as a potential freshwater species for development in Canada**
- **Grows well at high density and low temperature**



- **Subject to “dwarfism”, possibly a a result of social interactions**

‘ NEW ’ MODEL (BIJMA ET AL. 2007)

$$Z_i = \mu + A_{d_i} + E_{d_i} + \sum_{j \neq i} A_{s_j} + E_{s_j} + \varepsilon_i$$



EXPERIMENTAL RESULTS SO FAR

- **Encouraging results with hens, quails, & pigs**
- **Few experimental trials to date, particularly with aquatic species**
- **Difficulties with experimental design: many groups (1000's) of small size (4 hens, 9 pigs) produce best results**
- **Not easily applicable to aquaculture species!**

JANUARY 2012

From 24 Parent Sets

Raised in 3L Zebrafish Tanks

A FEW MONTHS LATER...

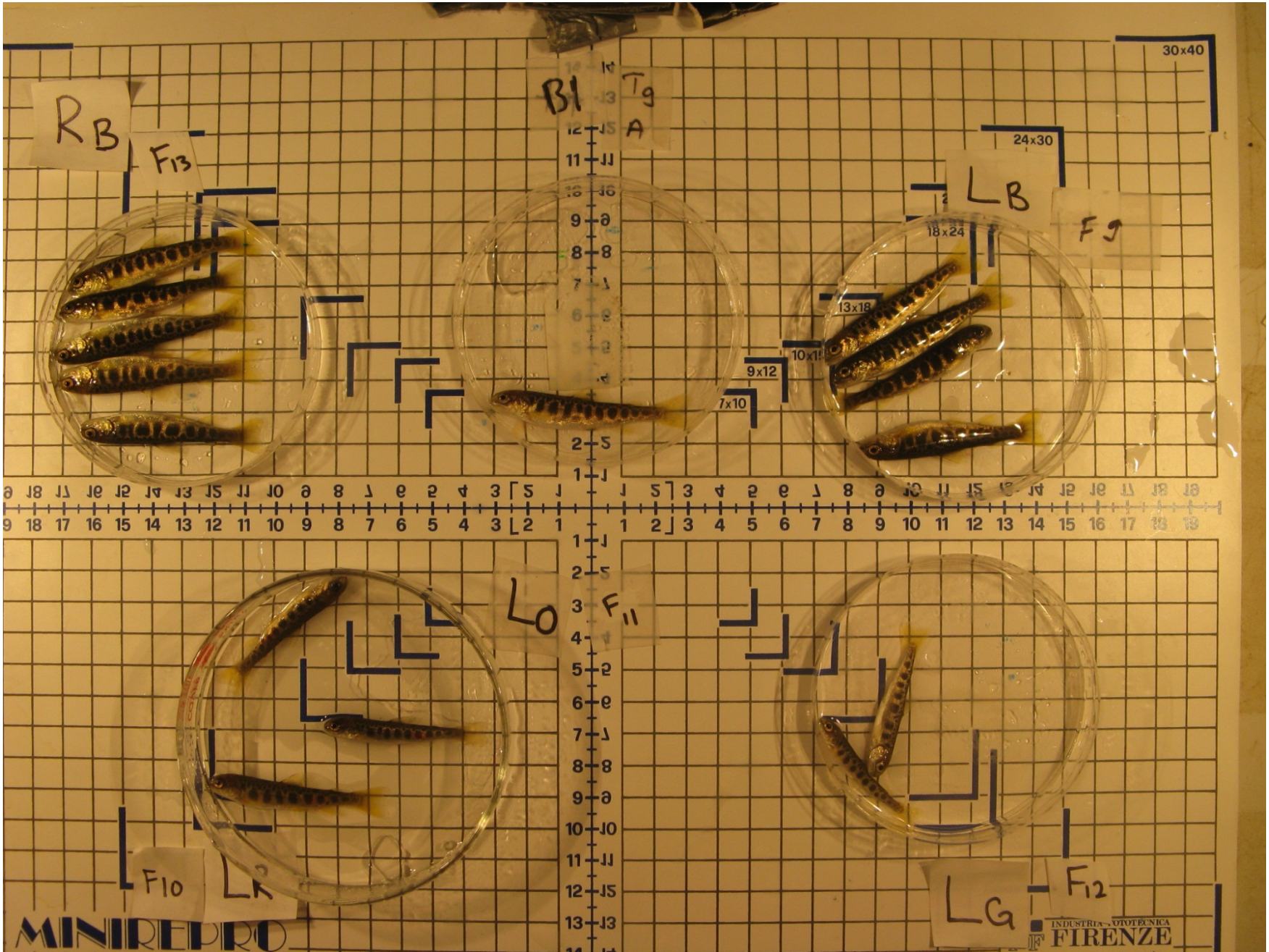
EXPERIMENTAL DESIGN

Unit	1	2	3
Tanks	24	24	14
Families/Tank	5	5	5
Fish/Family	10	10	4
Fish/Tank	50	50	20
Total Fish	1200	1200	280

VIE TAGGING

Family Identification

DATA COLLECTION



RESEARCH QUESTION

Is it possible to quantify the genetic basis of social interaction affecting growth in *Salvelinus alpinus*?

$$\sigma^2(A_d) \quad \sigma^2(A_s) \quad \sigma(A_d, A_s)$$

VC estimated using WOMBAT (Meyer, 2007), over several hundred runs, with varying starting values

RESULTS: ANIMAL MODEL

Unit	1	2	3
$\tilde{A}^2(Ad)$	0.240 ± 0	0.230 ± 0.085	0.266 ± 0
$\tilde{A}^2(As)$			
$\sigma(Ad, As)$			
Runs:	263	105	221
h^2	0.53	0.71	0.63

RESULTS: SOCIAL MODEL

Unit	1	2	3
$\tilde{A}^2(Ad)$	0.240± 0 0.238 ± 0.013	0.230 ± 0.085 0.138 ± 0.083	0.266 ± 0 0.244 ± 0.027
$\tilde{A}^2(As)$	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
$\sigma(Ad, As)$	0.001 ± 0.000	- 0.001± 0.001	-0.001 ± 0.001
Runs:	263	105	221

CONCLUSIONS SO FAR

Not easy to estimate these components. Need many runs, with varying starting values

No obvious evidence of non-zero $\tilde{A}^2(As)$ and $\tilde{A}(Ad,As)$ in these three experimental units

Why?

Not enough time for social interactions to affect fish length? ⇨ **Analyze condition factor (weight/length^3)**

Design (5 families/tank) not optimal?

Model not optimal? (scaling of social effects)

No genetic (co-) variance of social effects?

ON-GOING STUDY

2 famillies/tanks, 26 fish/tank
Fish individually ID'd
Longer time frame
Behavioural observations

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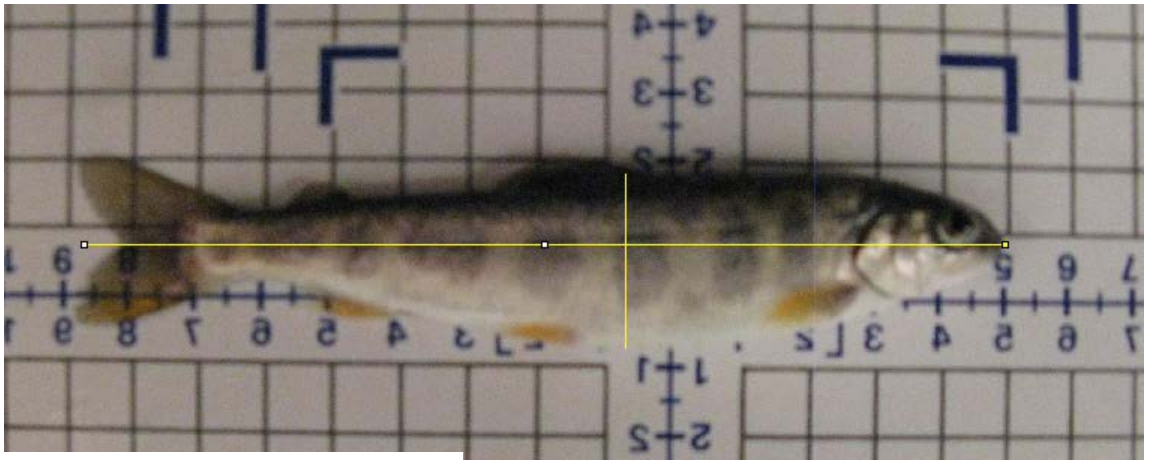
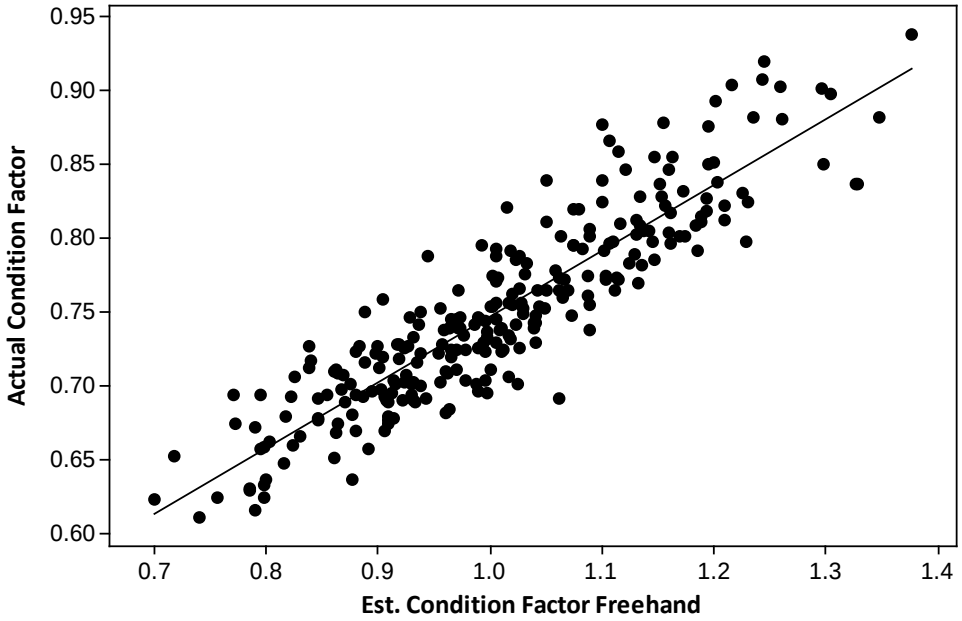
Kayla Menu-Courey

Eric Valant

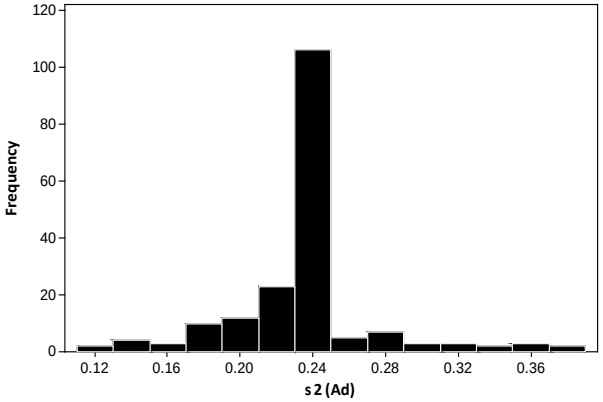
QUESTIONS?

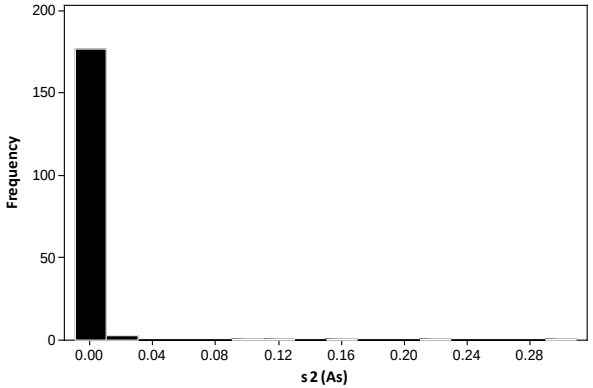
Condition factor





Images





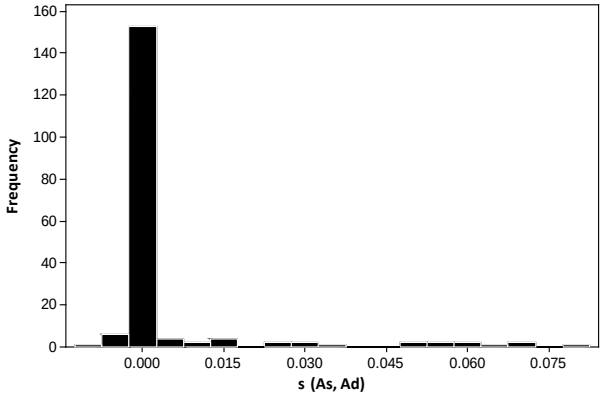


Figure 7: Distribution of variance and covariance of direct and social genetic effects for experimental unit 1 (a,b,c, estimated over 263 runs)

SIMULATION RESULTS