

Genetic parameters for direct and associative effect on survival in layers

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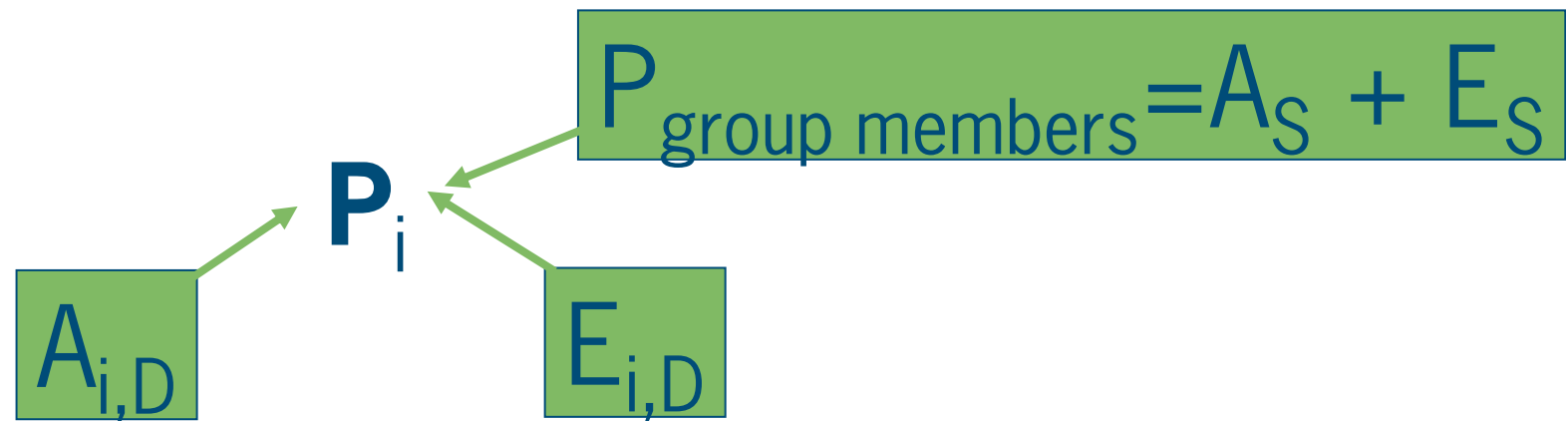
Introduction

- Social interactions
 - Mortality due to cannibalism a worldwide problem
 - Mortality depends on behaviour of group members
 - Social interactions provide a *heritable* social environment
-
- Traditional breeding inadequate → ignores effect group members
 - Extend traditional models, include associative effects (Griffing, 1967)

Theory - model

■ The Model:

- Direct effect of self
- Associative effect of group members



Aim

Estimate genetic parameters for both direct and associative effect on survival days in three purebred layer lines



Materials en Methods

- 17,018 hens
- 3 lines coded: W1, WB and WF
- 2 laying houses
- 4 birds/cage
- Randomly composed cages
- Intact beaks

- Trait is survival days

Survival days = number of days from start laying period till either death or end of the study (max is 447 days)

	N	No. sires	No. dams
W1	6276	36	537
WB	6916	35	537
WF	3588	20	295

Data analysis

- Separate per line
- Estimation of genetic parameters: Linear animal model (ASReml)
- 5 generations of pedigree
- Two models:
 - Direct effects model: $y = Xb + Z_D a_D + e$
 - Direct-Associative effects model: $y = Xb + Z_D a_D + Z_S a_S + e$
 - Y = observed survival days
 - Xb = fixed effects
 - a_D = vector of direct breeding values
 - a_S = vector of associative breeding values
 - e = vector of residuals: $e_i = E_{D,i} + \sum_{j \neq i}^{n-1} E_{S,j}$

Heritable variation

- Each individual interacts with $n - 1$ group members
- Total breeding value (TBV) = total heritable impact of an individual on the population mean: $TBV_i = A_{D,i} + (n - 1)A_{S,i}$

$$\sigma_{TBV}^2 = \sigma_{A_D}^2 + 2(n-1)\sigma_{A_{DS}} + (n-1)^2 \sigma_{A_S}^2$$

- The total heritable variance expressed as a proportion of the phenotypic variance equals

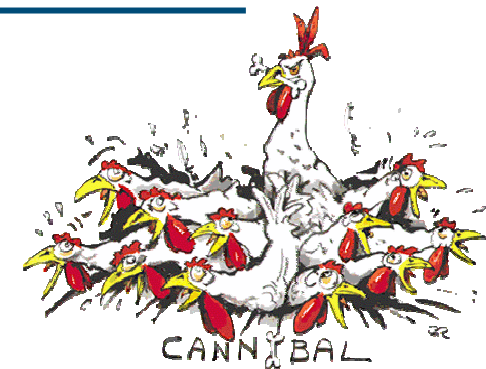
$$T^2 = \sigma_{TBV}^2 / \sigma_P^2$$

- T^2 = measure of “heritability”
- No interaction, $T^2 = h^2$

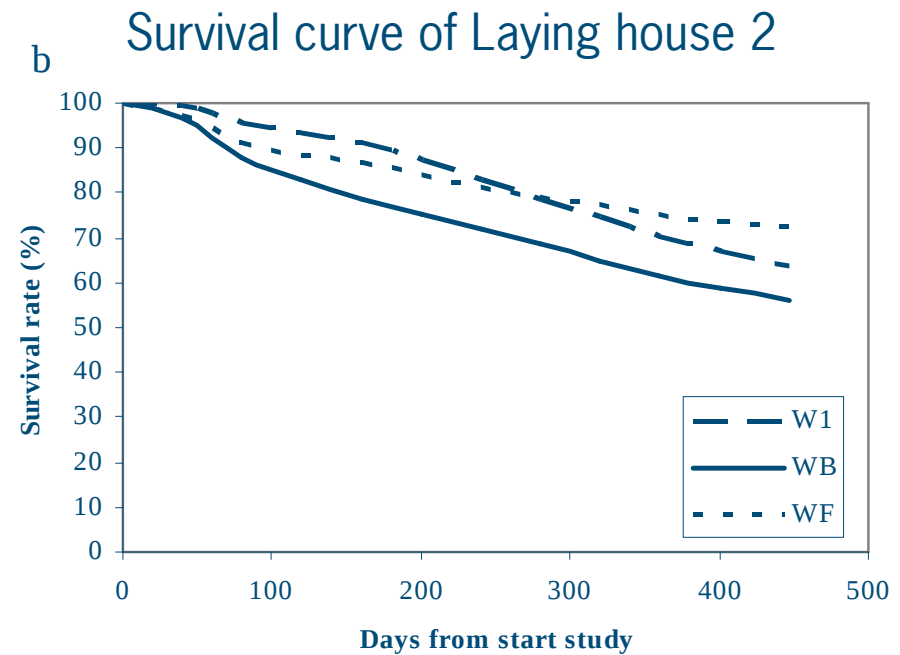
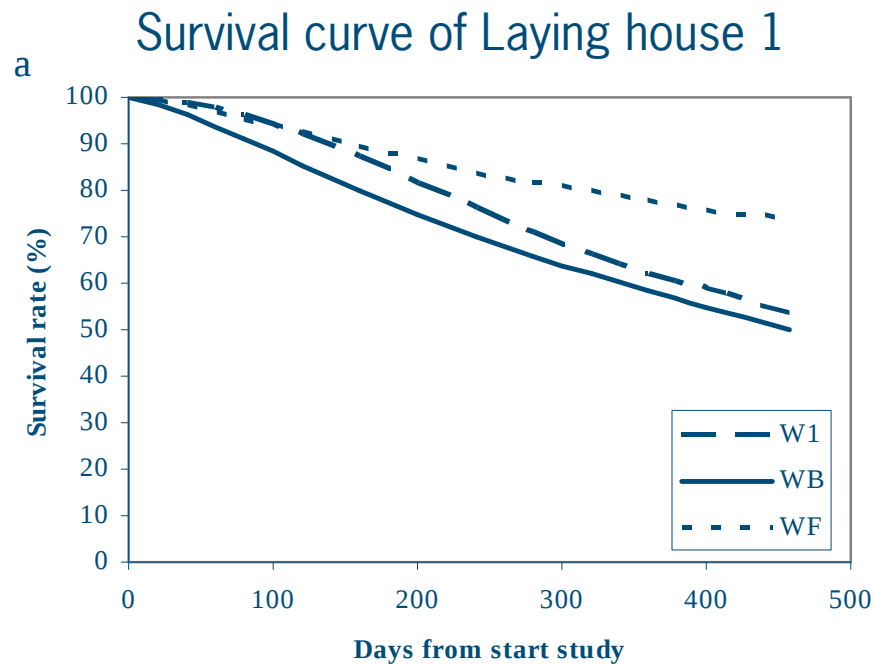


Results – survival rate

	Laying house 1 (%)	Laying house 2 (%)
W1	53.6	64.6
WB	50.2	56.3
WF	74.1	75.1



Results – survival curve



Results – genetic parameters



		W1	WB
Direct effects model	σ_{A_D}	30.4 days	44.4 days
	h^2	0.07 (± 0.02)	0.10 (± 0.02)
Direct-Associative effects model	σ_{TBV}	49.9 days	54.8 days
	T^2	0.19 (± 0.06)	0.15 (± 0.05)
	r_A	0.18 (± 0.21)	-0.31 (± 0.18)

$$T^2 = \sigma_{TBV}^2 / \sigma_{P_{grp}}^2$$

$$\sigma_{TBV}^2 = \sigma_{A_D}^2 + 2(n-1)\sigma_{A_{DS}} + (n-1)^2 \sigma_{A_S}^2$$



Discussion

- Proportion heritable variance 1.5 through 3 fold larger than currently believed using traditional model
- Results genetic parameters depend on:
 - Line
 - Environment: # animals/cage
- Differences in genetic parameters between lines
- Survival data not linear → survival analysis
- Estimating genetic parameters for direct and associative effect is rather “simple”
- Random cages

Conclusion

- Results are important for poultry breeding program
- Prospects for reduction of mortality using genetic selection are quite good!