Economically optimized selection index for the Finnish whitefish program

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GAME AND FISHERIES RESEARCH

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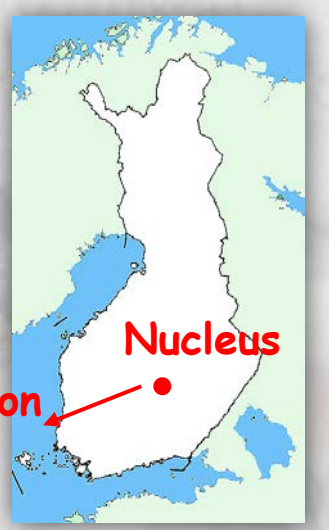
Finnish national breeding program for European whitefish (*Coregonus lavaretus*)



- Established in 1999
- Developed by two research institutes:
  Finnish Game and Fisheries Research Institute and
  MTT Agrifood Research Finland
- Max. 72 full-sib families / year class
- 100–150 parents / year class
- 3 generations of selection
- 5,000 ID-tagged fish / year class

- Selection and mating decisions are based on *the optimal genetic contribution method*
- Governmental program > distribution of improved material via commercial multipliers

Objectives

» Construct a multitrait selection index by combining economic and genetic values for whitefish traits

⇒ Development of an economically optimized breeding program for farmed whitefish

Acknowledgements

The staff at the Fisheries Research and Aquaculture stations in Tervo and Laukaa, and at the sea test station in Rymättylä

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Economic survey identified 13 traits contributing to supply-chain profitability

Production traits:

- Survival until harvest
- Harvest body weight
- Dressing %
- Fillet %
- Feed efficiency (feed intake / weight gain)
- Age at maturity

Quality traits:

- Condition factor (body shape; **g/cm^3**)
- Fillet lipid %
- Caviar %
- Meat texture
- Fillet gaping
- Fillet colour
- Meat water holding capacity

Optimizing selection

- First, economic values for each trait calculated with the bio-economic model
  - The rate of change in the whole supply-chain profit when a trait changes one unit
- Then, the economic values combined with the genetic selection potential of each trait
  - These standardized values are comparable across traits

→ The importance of traits for selective breeding

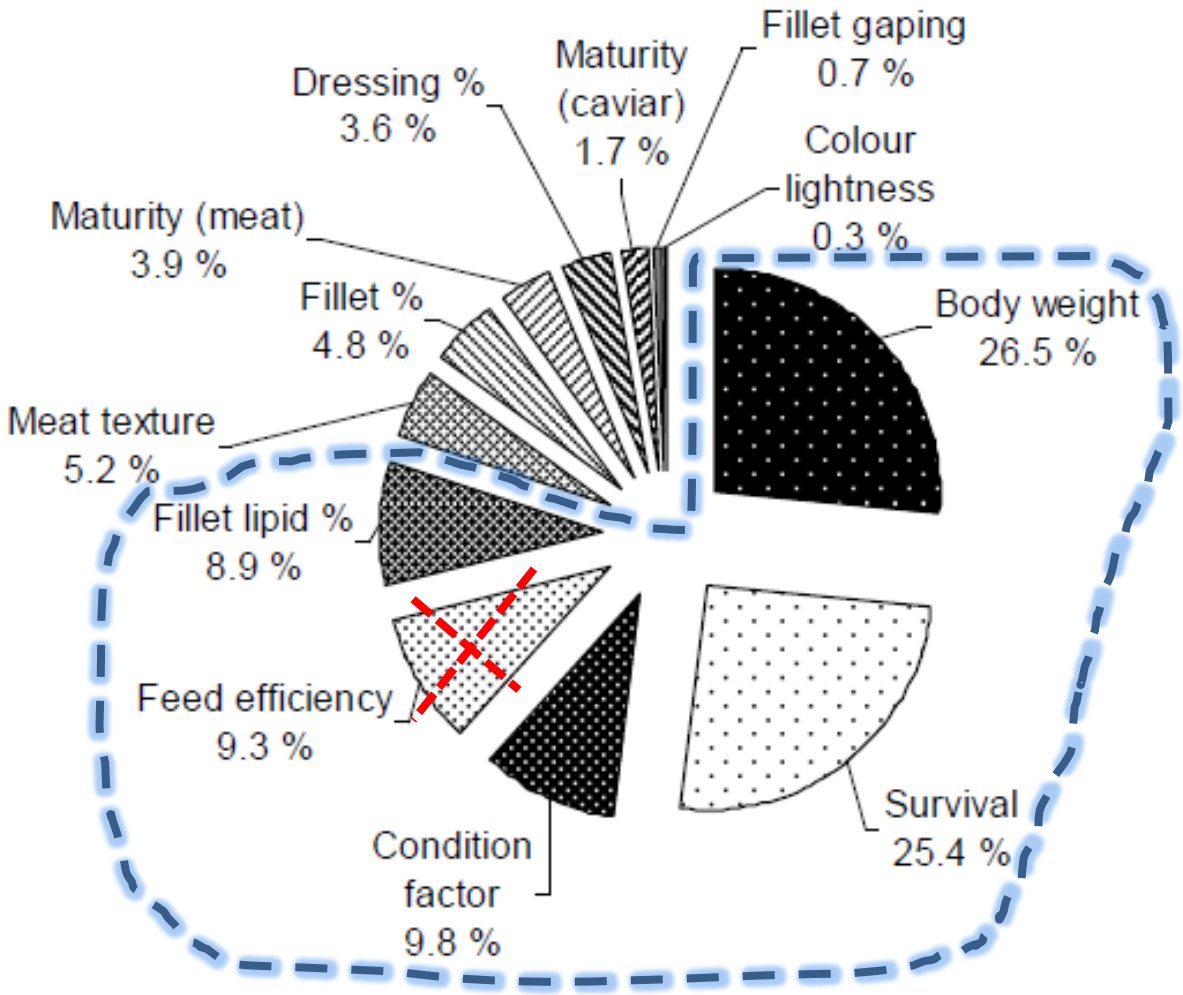
↳ Optimal selection (Hazel 1943; Gibson & Wilton 1998)

Economic values (***a***) and the aggregate genotype (***H***) for whitefish

	Absolute *a* (€ × 1000 per increase in trait unit)	**Breeding value of a trait**	**Heritability (h^2)**
H =	**5.7**	*EBV*(Body weight)	**0.35–0.46**
	+ 4417.3	*EBV*(Survival)	**0.19 / 0.30***
	- 1784.0	*EBV*(Condition factor)	**0.63**
	+ 5685.4	*EBV*(Feed efficiency)	**0.06**
	- 14350.2	*EBV*(Fillet lipid %)	**0.40**
	+ 42132.5	*EBV*(Meat texture)	**0.30**
	+ 16291.3	*EBV*(Fillet %)	**0.10**
	- 592.4	*EBV*(Maturity)	**0.17 / 0.27***
	+ 14803.2	*EBV*(Dressing %)	**0.14**
	- 73.5	*EBV*(Fillet gaping)	**0.01 / 0.02***
	+ 8.6	*EBV*(Fillet colour, lightness)	**0.16**

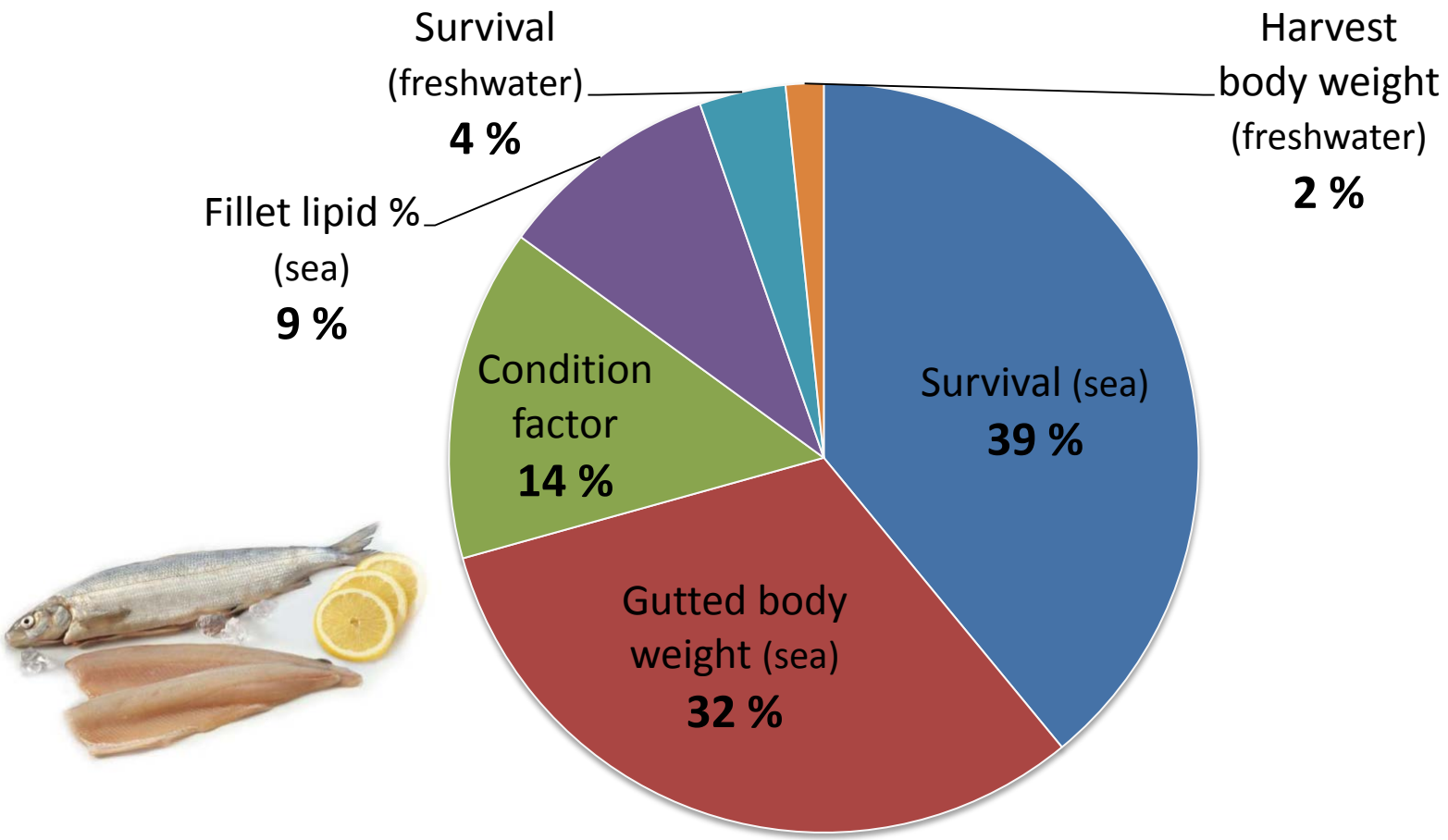
*Heritability calculated on the liability scale following Dempster and Lerner (1950)

Relative economic importance of traits



Standardized economic values ($a_s = a \times SD_G$) expressed as percentages

Practical approach accounting for genotype-by-environment interaction



Relative importance of traits in the selection index for European whitefish

Genetic correlations (±SE) for the selected traits

	Harvest BW (freshwater)	Gutted BW (sea)	Survival (freshwater)	Survival (sea)	Fillet lipid % (sea)
Gutted BW (sea)	**0.544** (0.107)				
Survival (freshwater)	**0.400** (0.080)	0.004 (0.128)			
Survival (sea)	0.254 (0.135)	**0.379** (0.110)	0.105 (0.132)		
Fillet lipid % (sea)	**0.288** (0.140)	**0.581** (0.100)	-0.090 (0.145)	0.231 (0.129)	
Condition factor	**0.319** (0.121)	**0.715** (0.067)	-0.204 (0.124)	0.147 (0.111)	**0.516** (0.108)

Predicted percentual genetic change when selection intensity = 1

Harvest BW (freshwater)	+7,5%
Gutted BW (sea)	
Survival (freshwater)	+6%
Survival (sea)	+20%
Fillet lipid % (sea)	+1%
Condition factor	+2%

Outcome

- The present selection index includes the four economically most important traits
- Each trait can be reasonably measured

⇨ Improvement of the whole supply chain profit is optimized by increasing survival and growth of fish while restricting unfavourable changes in body shape and lipid deposition

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