AquaIMPACT

Nutrition and breeding

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On The Horizon

EATiP Aquaculture Project Dissemination Service

Improving resource efficiency and disease resistance of farmed fish by selective breeding

29 September 2021

Antti Kause
Luke (Natural Resources Institute Finland)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 818367 – AquaIMPACT - Genomic and Nutritional Innovations for Genetically Superior Farmed Fish

INDUSTRY NEED

Feed conversion ratio (FCR) and fillet yield

- Feed costs are around 30-50% of production costs
- Feed production is a major source of climate change effects
- More eatable fillet with same amount of feed

Disease resistance and survival

- Profitability and fish welfare

What is the evidence that these traits can be improved by selective breeding and benefit farmers?

prokala.fi/pro-kala/mediapankki/

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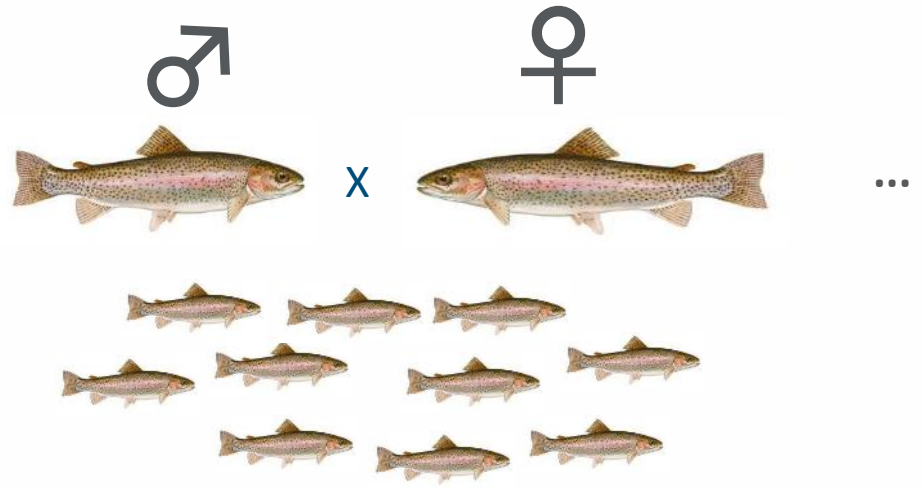
SOLUTION, part 1



Selective breeding based on pedigree

- Sire-dam-offspring pedigree information
- Select superior individuals from best families to become parents

➡ Genetically improved fish distributed to farmers

It is well documented that growth is genetically improved 5-10% per generation (Gjedrem & Rye. 2018. Rev. Aquac. 10:168-179) but what about other traits?

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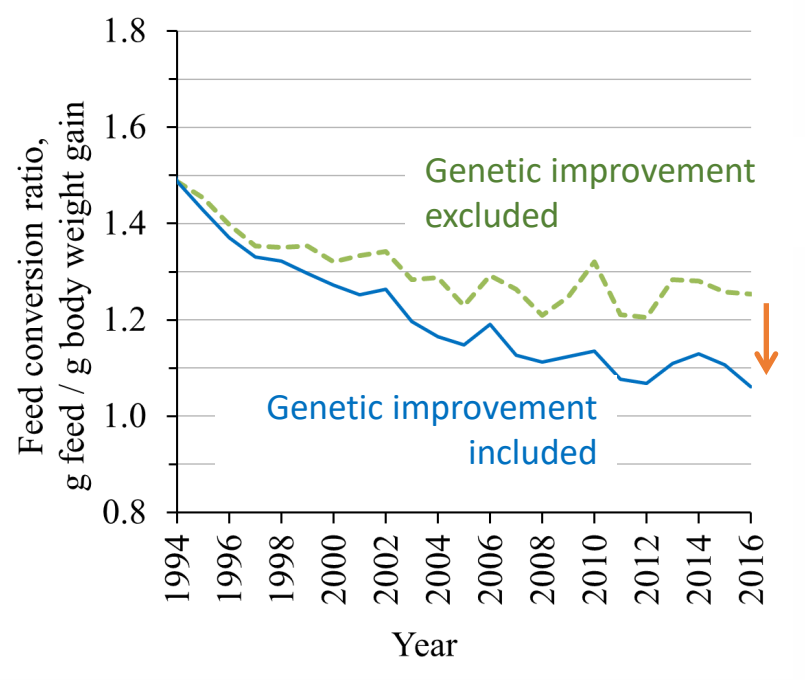
RESULTS and IMPACT: Expected genetic improvement of FCR in rainbow trout



Due to genetics Today, 18.1% better FCR in farming

Benefit for the industry

- Feed cost down by 18.1%
- Total production costs down by 7.8%

Example, assume:

- Feed cost 1.382 €/kg feed
- 10M kg fish production
- FCR from 1.253 -> 1.061

-> 2.6 M€ per year, feed cost reduction

+ Positive environmental effects

Genetic trend analysis across generations

- A total of 23 year classes from 1992 to 2015
- 8 generations and 7 episodes of genetic selection
- 525 247 individuals (Luke VOAS data)
- And, production data > 100 commercial farms (ELY center data)

Luke NATURAL RESOURCES INSTITUTE FINLAND

Kause et al. submitted

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RESULTS and IMPACT: Realised selection response in rainbow trout

Comparison: Fish selected for 10 generations **vs** Generation 0 fish

Trait	Gen 0	Gen 10 selection	Difference %
Body weight (day 374)	1048 g	1665 g	+59%
TGC growth rate (days 264-374)	2.07	2.65	+28%
FCR (days 264-374)	1.19	0.97	-19%
Fillet yield (day 374)	67.7%	69.1%	+2%

3 replicate tanks per strain

Benefit for the industry, fillet%:

- 2% more fillet
- 2% more income from fillet sales

Example, assume:

- Fillet price of 7.4 - 16 € / kg
- 10M kg fish production

-> 1.0 - 2.24M € per year, more income from fillet sales

+ Less waste

Vandeputte et al. in prep

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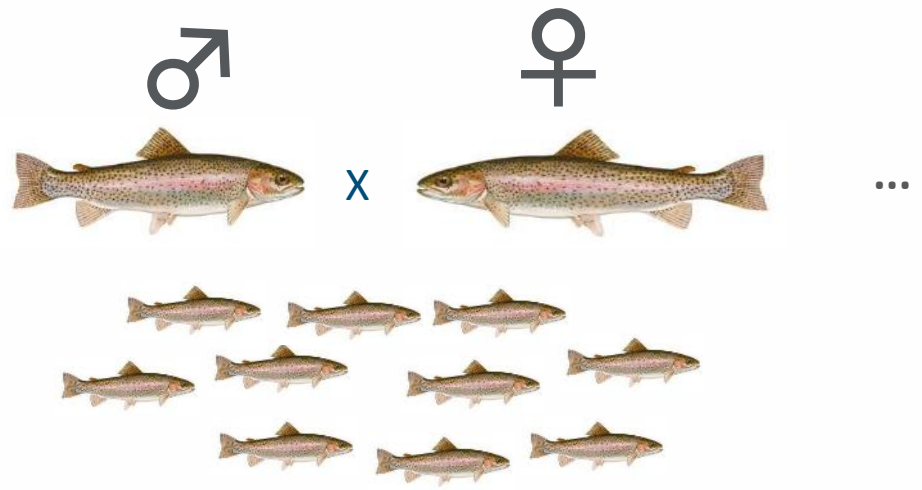
SOLUTION, part 2



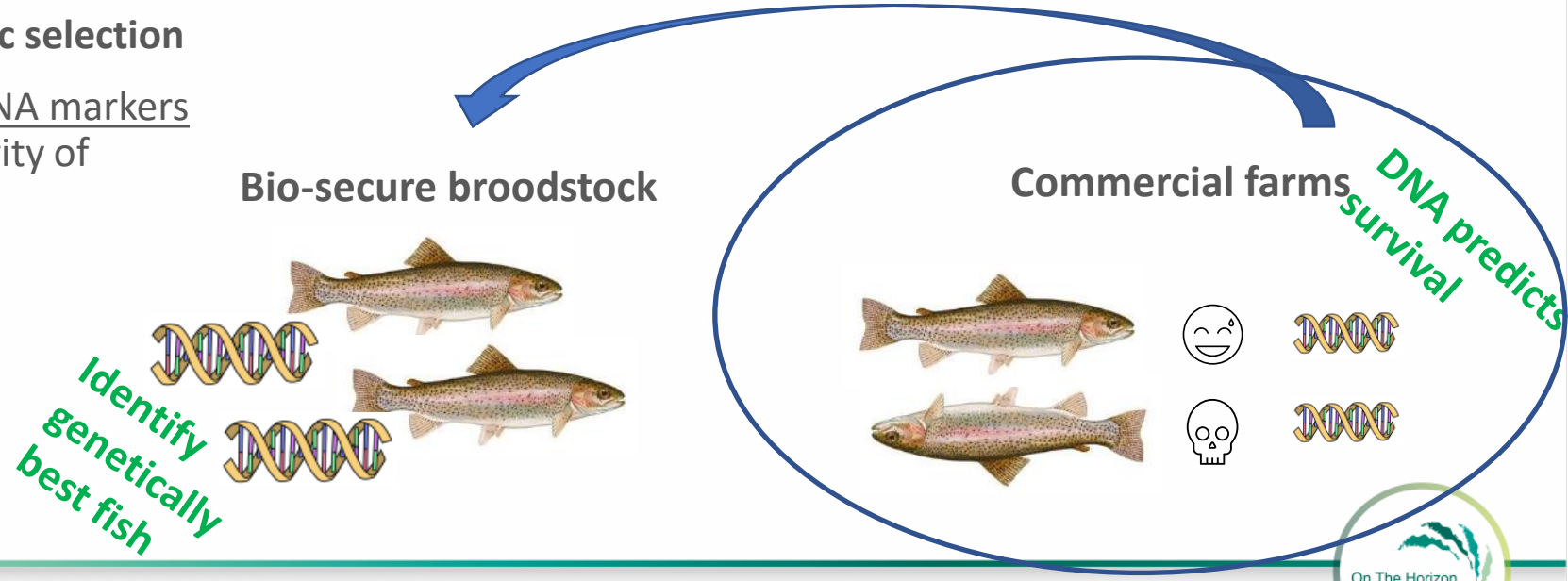
Selective breeding based on pedigree

- Select superior individuals from best families
- Sire-dam-offspring pedigree information

Selective breeding based on genomic selection

- Tissue sample and thousands of DNA markers are used predict the genetic superiority of individual broodstock fish

Benefits: Novel traits, more accurate identification of superior fish



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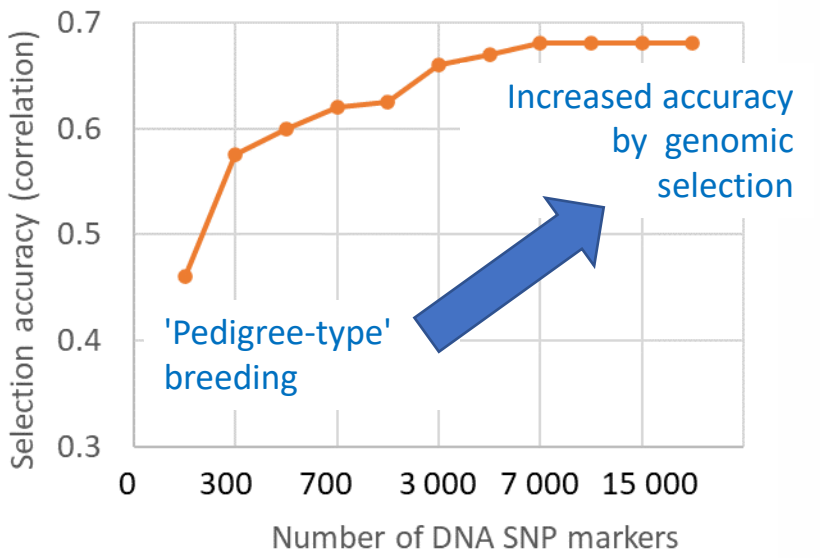
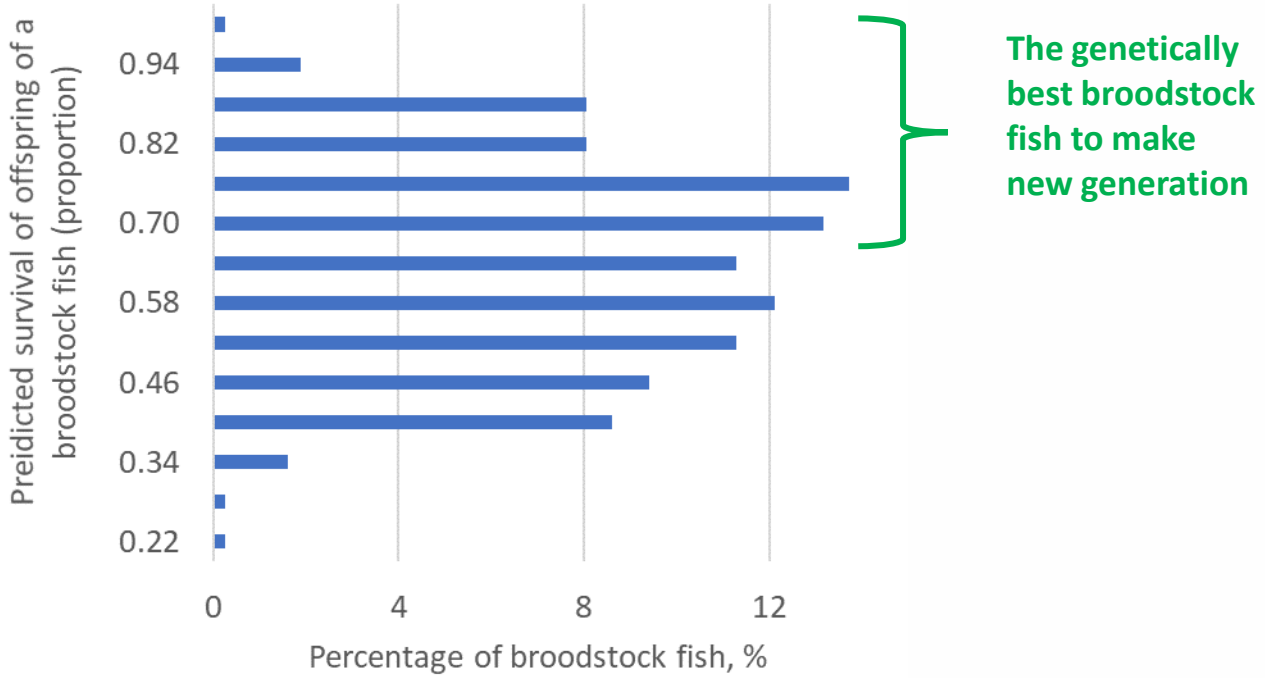
RESULTS and IMPACT: Efficiency of genomic selection in rainbow trout to improve survival against *Flavobacterium columnare*

- **Predict genetic resistance against warm-water *Flavobacterium columnare* - disease**
- Major disease in fingerling phase
- 30,000 rainbow trouts from 100 families
- 1500 (survivors) + 1500 (died) fish genotyped
- 28.000 SNP DNA markers



- Genomics reveals large genetic differences
- Range from 22% - 95% in expected offspring survival of broodstock fish



Fraslin et al. in prep

Savon Taimen

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CURRENT STATUS

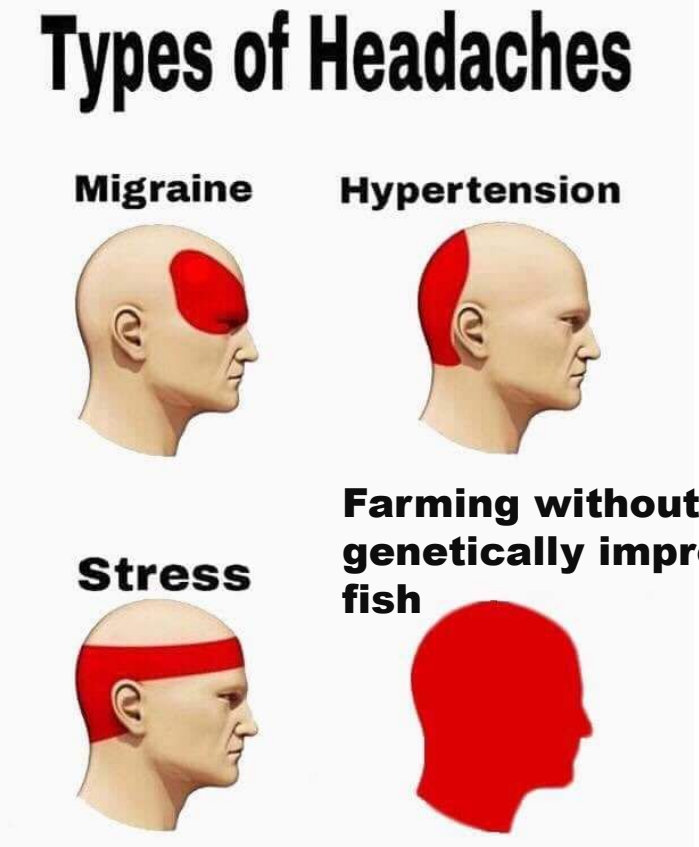
Impact of selective breeding methods

The results were from on-going breeding programmes from which improved fish are distributed to fish farmers

- Breeding companies
- Farmers
- Processing industry
- Environment impact

Genomic selection implemented

- **Atlantic salmon: (2016), rainbow trout (2017), Gilthead sea bream (2019), European sea bass (2019), Pacific oyster (2020)**
- Other aquaculture species, in progress



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THANK YOU!

Antti Kause
AquaIMPACT coordinator
Natural Resources Institute Finland (Luke)

Email: antti.kause@luke.fi

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