Sustainable breeding of important European aquaculture species

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Motivations

- Climate change is one of the major global concerns with no exception to aquaculture
  - Growth of performance is dependent on water parameters (e.g., temp)
  - Increased risk for more opportunistic disease outbreaks

- Fish farming relying on fish meal and fish oil as feed ingredient is not a sustainable practice
  - Need to use alternative raw materials in fish feed

- How does climate and/or the feed formulation affect economically important traits?
  - E.g., growth, survival, disease resistance

Objectives

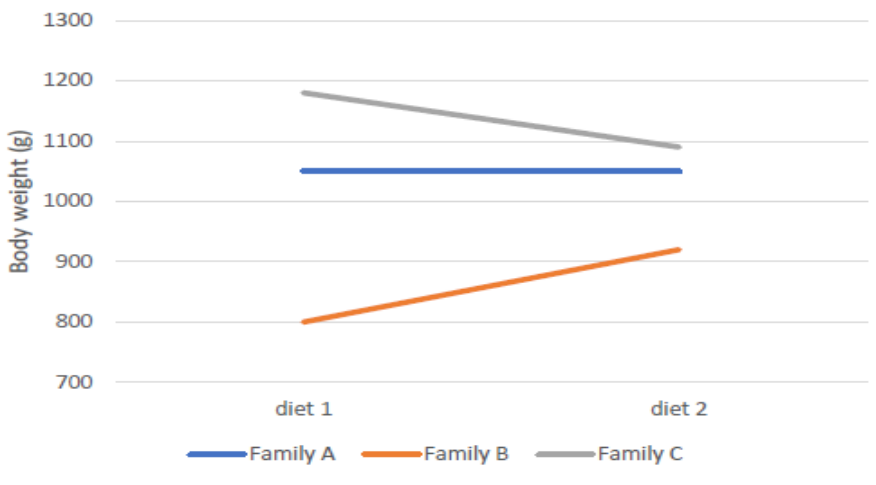
To **assess**, **validate** and **demonstrate** the level of the ability of the current breeding programs, their breeding goals and methodologies in four of the main European aquaculture species to answer the future challenges of:

1. Increased need for utilization of alternative feed sources in aquaculture feeds.
2. Need for resilience in the face of climate change.
3. Maintained and increased animal welfare through robustness and disease resistance.

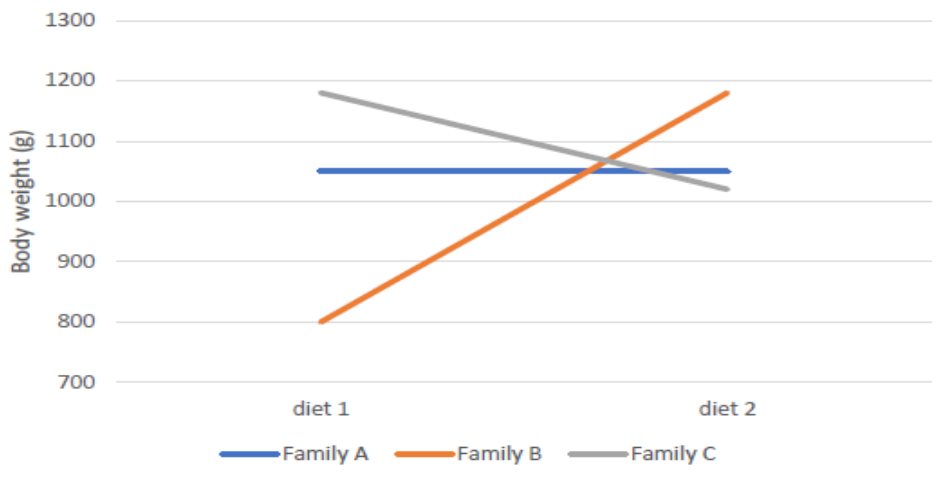
Genotype-by- Environment (GxE)

- Genetic by environment interaction (GxE)
  - Tells if there is a variation in performance under different environments
  - Discrepancy between expected and realized performance

- Studying of GxE, will provide valuable information on how aquaculture breeding can prepare up front to future challenges.



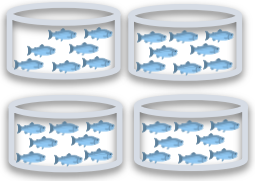
Scaling



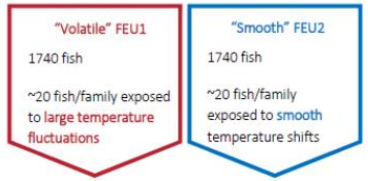
Re-ranking

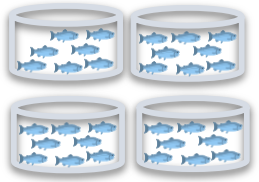
Genotype by Climate

67 Families (BGN)
N=~3231

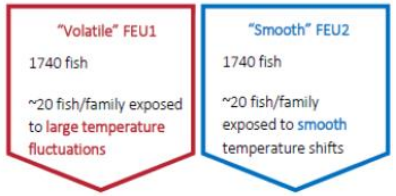


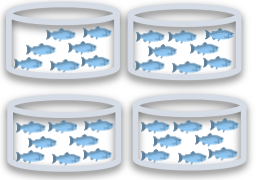
88 Families (AVRAMAR)
N=~6960





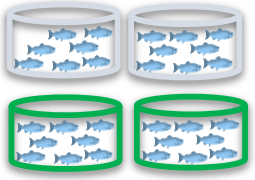
117 Families (AVRAMAR)
N=~6829



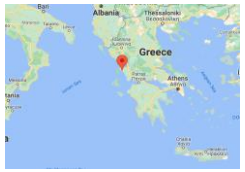


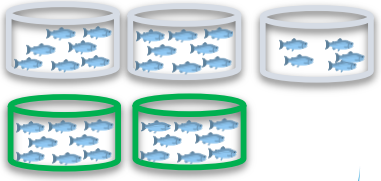
Genotype by Diet

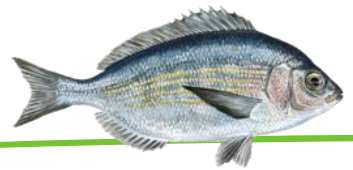
67 Families (BGN)
N=~2935



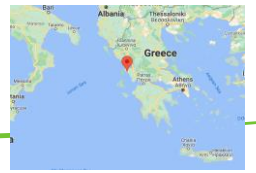
88 Families (AVRAMAR)
N=~10958

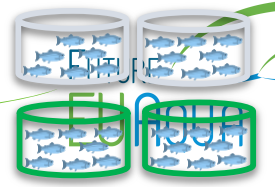






117 Families (AVRAMAR)
N=~11679





Genetic parameters for GxE

Genotype by Climate

Species	Heritabilites (EWT)	Genetic correlation
SALMON	0.46 - 0.58	0.93 ± 0.06
SEABASS	0.21 – 0.23	0.99 ± 0.04
SEABREAM	0.32	1.01 ± 0.03

Genotype by Diet

Species		
SALMON	0.44 – 0-45	0.99 ± 0.01
SEA BASS	0.30 – 0.35	0.92 ± 0.05
SEABREAM	0.14 – 0.16	0.92 ± 0.07

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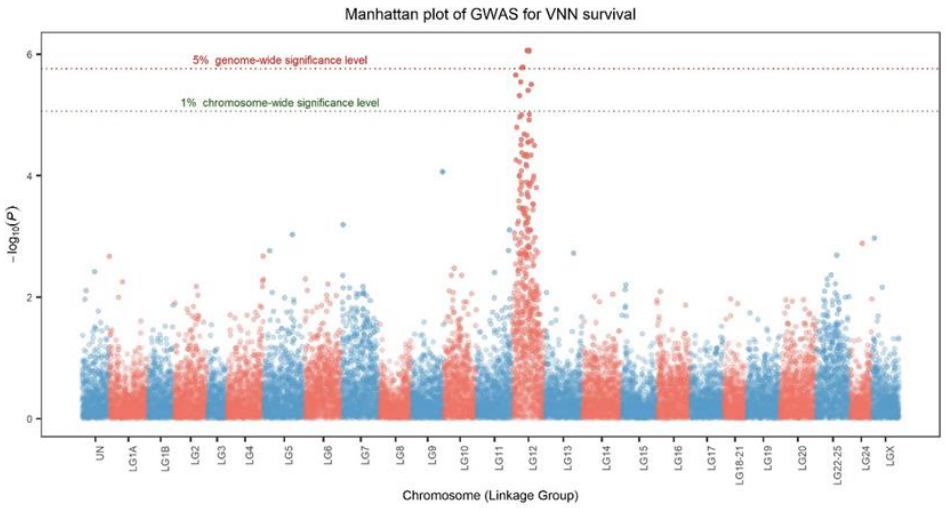
Validation of selection methods

- Validate different selection methods for disease resistance and production traits for maintaing and increasing animal welfare

Traits	Parents	Realized response 10% best families	
	Selection criteria	Conventional	Innovative
Body weight	BLUP EBV	+13%	+9%
	GS GEBV	+18%	+15%
Pigmentation	MAS (QQ vs qq)	Up to 22%	Up to 16%

Salmon

Seabass



survival 10% best/worst families from parent prediction		
est	8 worst	Contrast
%	27 %	8 %
%	26 %	20 %
%	20 %	23 %

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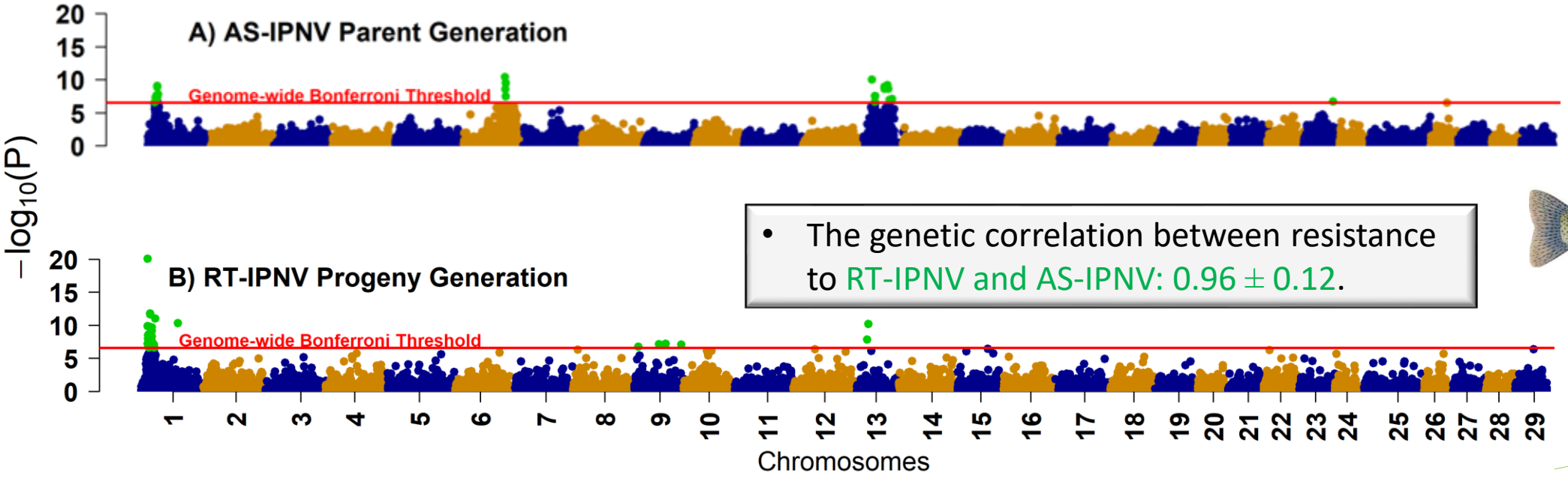
Validation of selection methods

Traits	Parent grouping (Best vs worst)	Contrast of best vs worst families	
		Conventional	Innovative
Body weight	BLUP EBV	-	-
	GS GEBV	6%	8%

Seabream



- The genetic correlation between resistance to RT-IPNV and AS-IPNV: 0.96 ± 0.12.

Rainbow trout

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Summary

- High genetic correlation between growth traits across environments and diets → no significant GxE
  - Resilience regarding climate change and novel feeds is expected to
    - Help in resource optimization
    - Promote predictable and sustainable aquaculture production

- Validation of selection methods
  - Growth in Atlantic salmon and Gilthead Sea bream
  - VNN disease resistance for European sea bass

- Identification of consistent QTL/SNPs affecting survival against:
  - Viral nervous necrosis (VNN) in European sea bass
  - Infectious pancreatic necrosis (IPN) in rainbow trout

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Thank you for your attention and contribution!

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