Sonal Patel/Aquaculture health

Effect of biosecurity measures on pathogen persistance in RAS

Norwegian
Veterinary Institute

Why RAS?

2010 and onwards

- Longer phase on land - shorter seawater phase
- Water limitation

Production: 1000 to 5000 tons/annum

Number of stockings: 3 to 7 per annum

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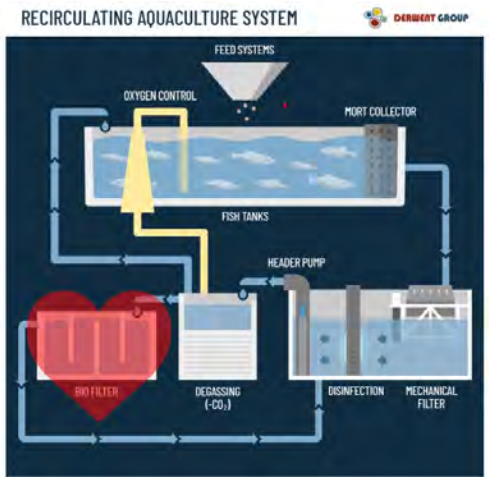
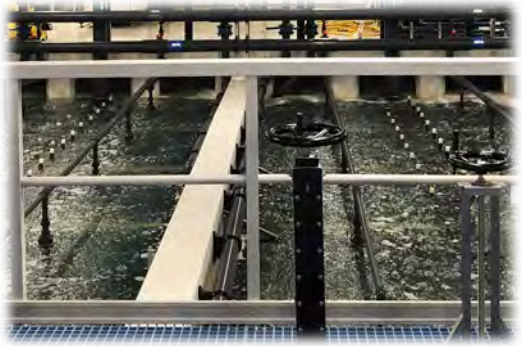
Recycling Aquaculture System (RAS)

‘Heart’ of the system = biofilter



MBBR

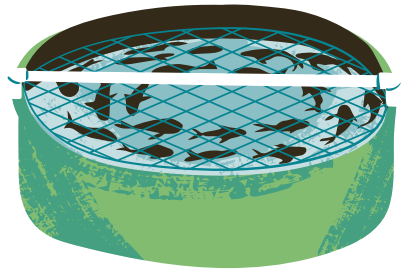


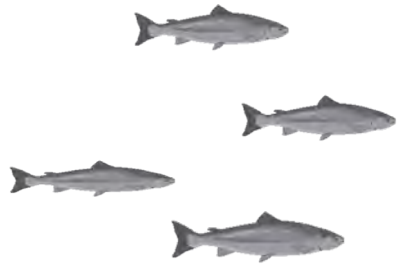
FBBR

- Many advantages
  - ✓ Biosecurity
  - ✓ Control of water quality parameters
- Age of biofilter is important - takes time to achieve stable and mature biofilters – outcompetes invading pathogens?
- Lack of knowledge about several factors (survival & establishment of agents + methods to get rid of those)

Pathogens in RAS, Norway

- *Ca*. Branchiomonas cysticola
- *Yersinia ruckeri*
- *Pseudomonas* spp.
- Infectious salmon anaemia virus (ISAV) HPR0
- Infectious pancreatic necrosis virus (IPNV)
- Piscine orthoreovirus (PRV)
- Saprolegnia
- +++++





Clear separation between generations?

Map reservoir(s) and identify risk areas for pathogen persistance

Larsen, Sondre Veberg., Tørud, Brit., Hess-Erga, Ole-Kristian., Furseth, Kamilla., Patel, Sonal. (2024).
Praktisk biosikkerhetsarbeid i resirkulerende akvakultursystemer (RAS).
Akvaplan-niva rapport nr. 2024 64276.01 og VI rapportserie 2024_5. ISBN 97-82-449-0074-4.
FHF - prosjektdatabasen

Biosecurity measures (BM):

1. Fish out of system
2. BM1 + wash & disinfect tanks
3. BM1 &2+ partial wash and/or disinfection of water treatment system
4. BM1-3, Sanitization of whole system including bioreactor

Additional: varying period of **Fallowing**

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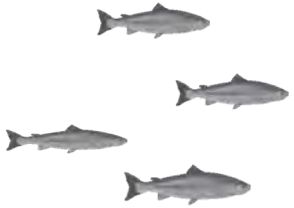
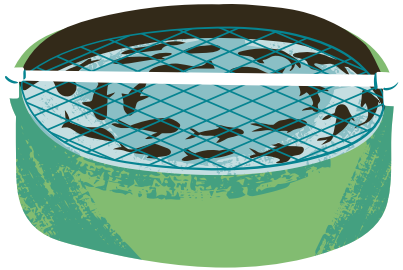
Identify practices and test in trial

Test effect of different biosecurity measures in use in the Norwegian Industry

- Fallowing
- Cleaning and water exchange
- Ozonation

- **Survey of industry biosecurity**
- **Experimental trials**
- **Commercial RAS facilities**





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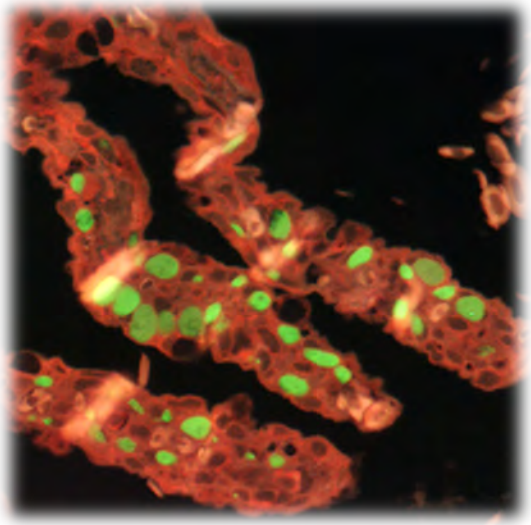
Agents studied:

- Infectious Salmon Anaemia Virus (ISAV) HPRdel (virulent)

- *Ca*. Branchiomonas cysticola
  - Infectious pancreatic necrosis virus (IPNV)
  - Piscine Orthoreovirus (PRV)



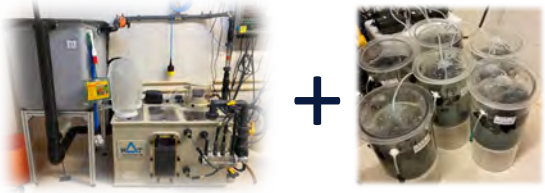
Experimental trials

3 RAS Tanks

Biofilter acclimation/maturation

1. Fish death/removal of infected fish

2. Biosecurity measures and RAS Bioreactors assembly

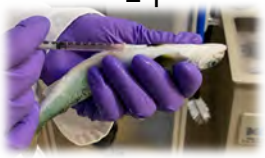


Phase I pathogen shedding

Phase II Fallowing and effect of measures

ILAV

Days -35 -14 00 03 07 10



IP challenge: smolt 50 g

Naïve fish introduction

Ca. Branchio +IPNV+PRV

Days -35 -21 00 5 hrs 2 4

Transport of infected smolt from Farm - ~78 g

Transport water – neg

Fish:

100% pos Ca. B. cysticola, PRV

67% pos IPNV

Termination of exp, sampling of introduced naïve fish

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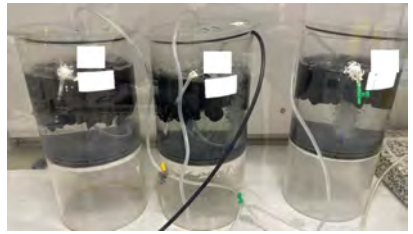
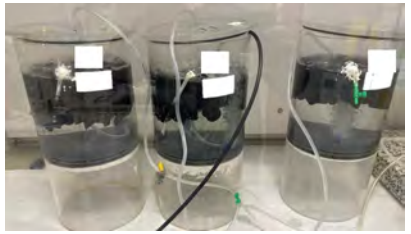
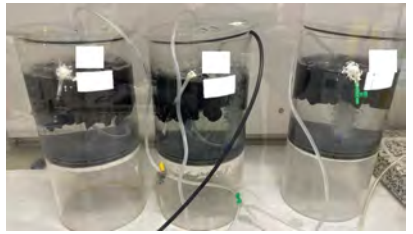
Phase II: small scale reactors



No treatment

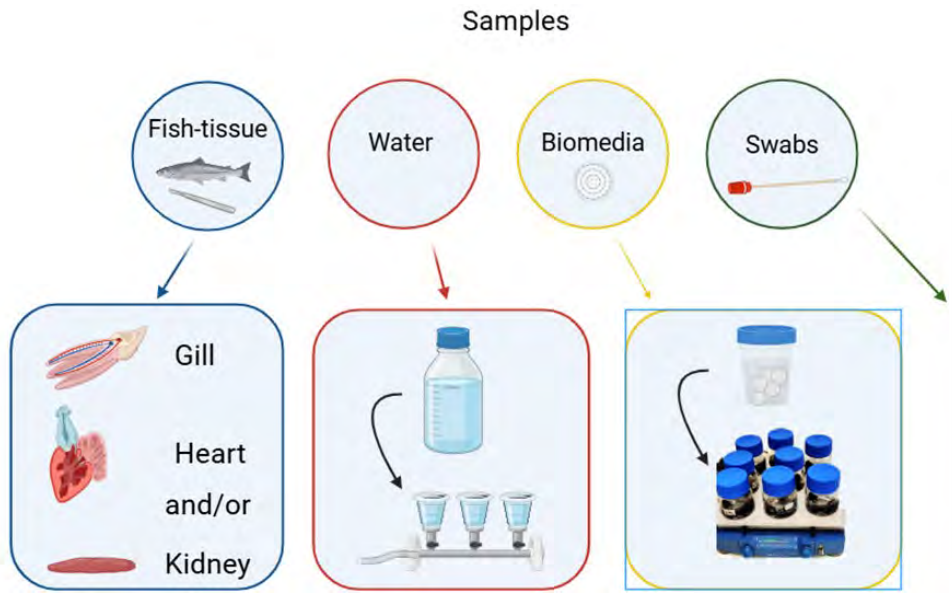


Scrubbing/Water replacement



Ozonation

Sampling, processing and analyses

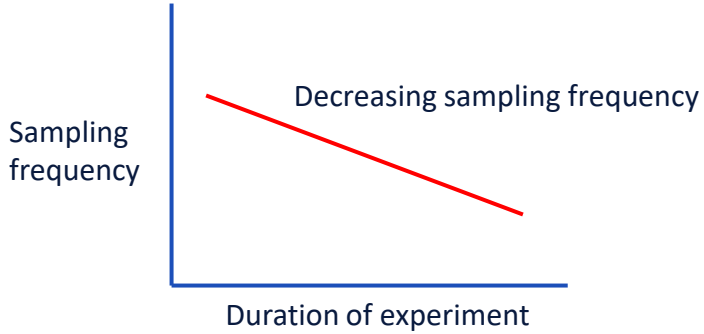


Infected "shedders"/ Nâive fish at termination

- qPCR
- Histology
- Immunohistochemistry

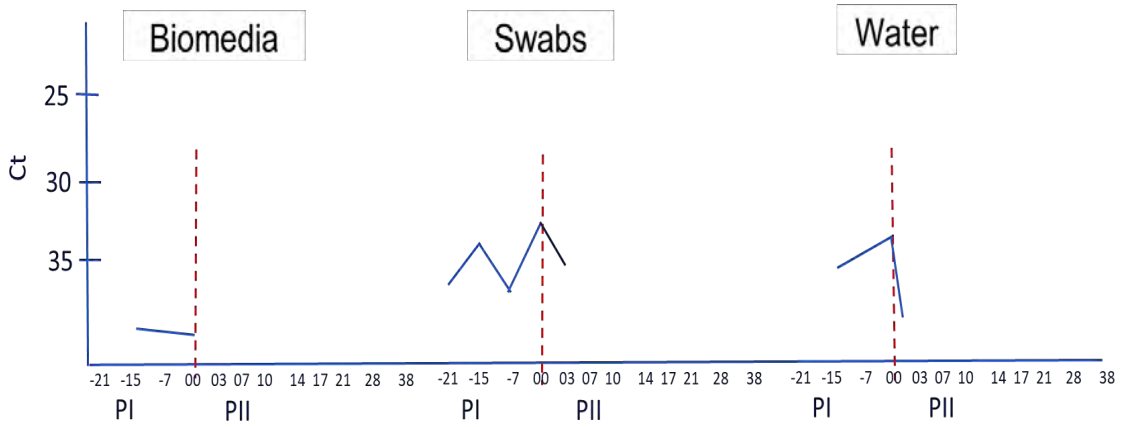
Analysis

- qPCR
- IFAT staining



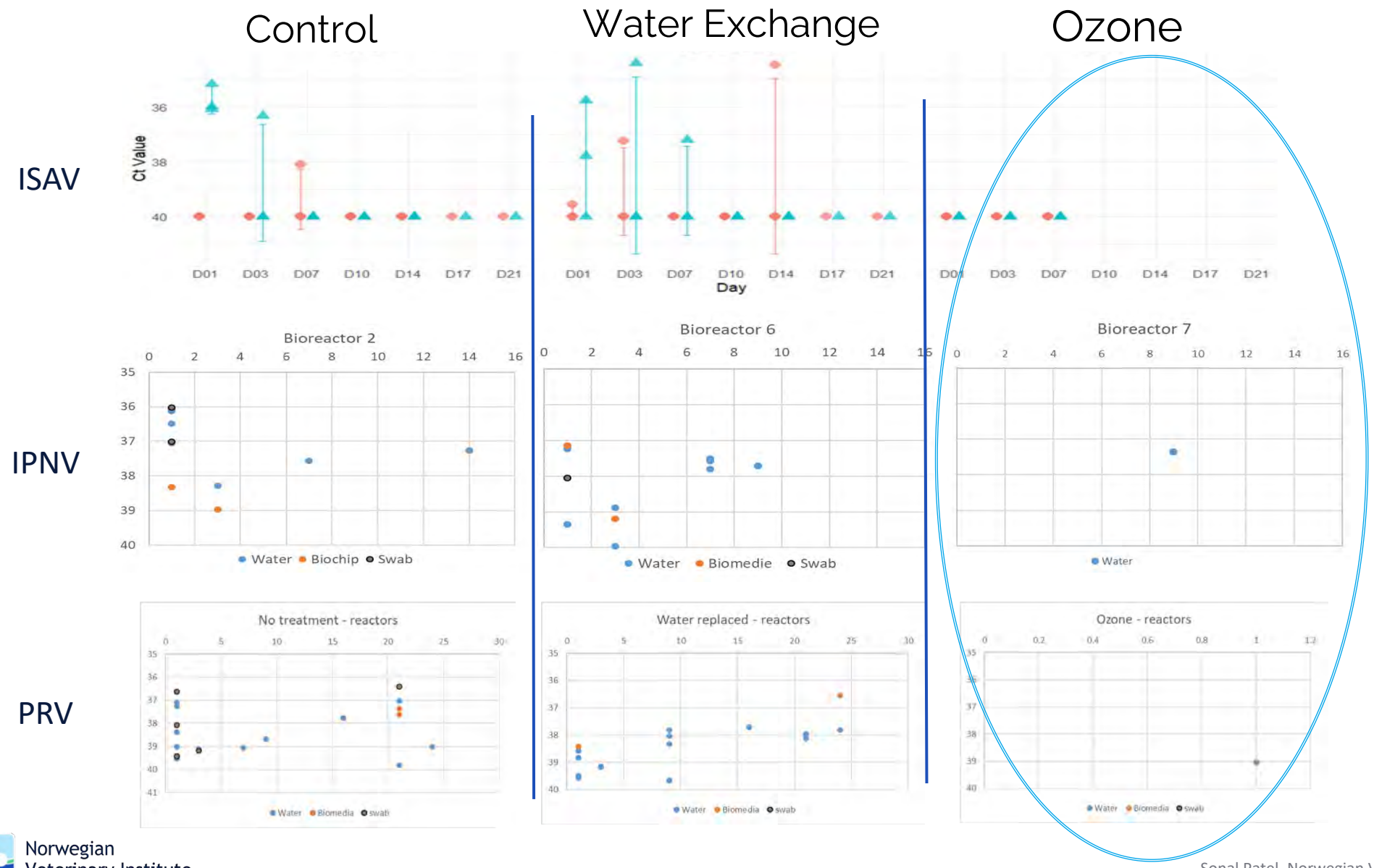
Persistence- Substantial pathogen dependent variation

Ca. B. cysticola



Small reactors

Ca. B. cysticola: D1 water (No treatment); swab (ozone): Ct 38 - 39



Water
Biomedia
Swab

Summary – lab trials


BRAS
Vitenskapet

Spredning, overlevelse og inaktivering av fiskepatogener i labskala-RAS

Treatments

Fallowing :

Effective: *Ca.* Branchiomonas and ISAV HPRdel (virus degradation over time?)

- Pathogen load too low to sustain infection?
- Short persistence following removal of fish

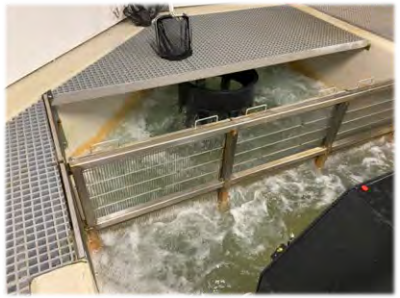
Not effective: IPNV, PRV - näive fish positive at termination- so short-term (4 days) fallowing ineffective

Water exchange/replacement: NO real effect

Ozonation: effective for elimination of ISAV HPRdel & *Ca.* Branchiomonas, but not completely for IPNV and PRV?

- Effect on biofilter flora? Effect on water quality
- Microbiome studies now being analysed…..STAY TUNED!

Commercial RAS facilities



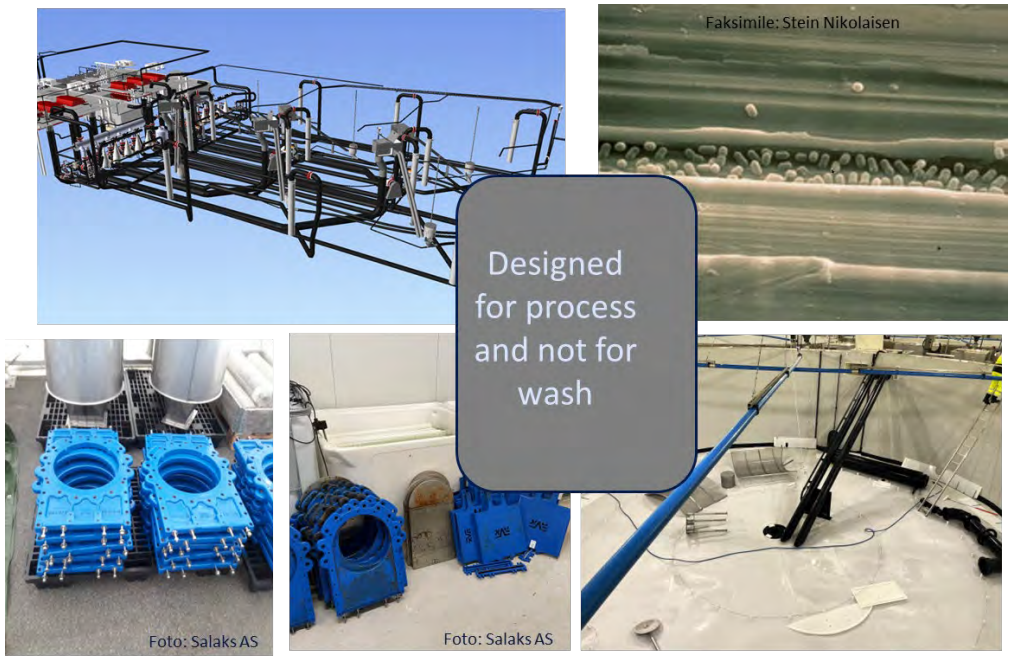
6 cases:

- *Ca.* Branchiomonas cysticola – 2 sites
- PRV – 3 sites
- IPNV – 1 site + historical case
- HPR0 – 1 site

Thanks to Industrial partners:

Osland Settefisk
Salmar Settefisk
Erko Settefisk
Helgeland Smolt
Grieg Seafood ASA
Lerøy Aurora
Salangfisk
Mowi ASA
Hardingsmolt AS
Ænes Inkubator AS

Commercial RAS facilities



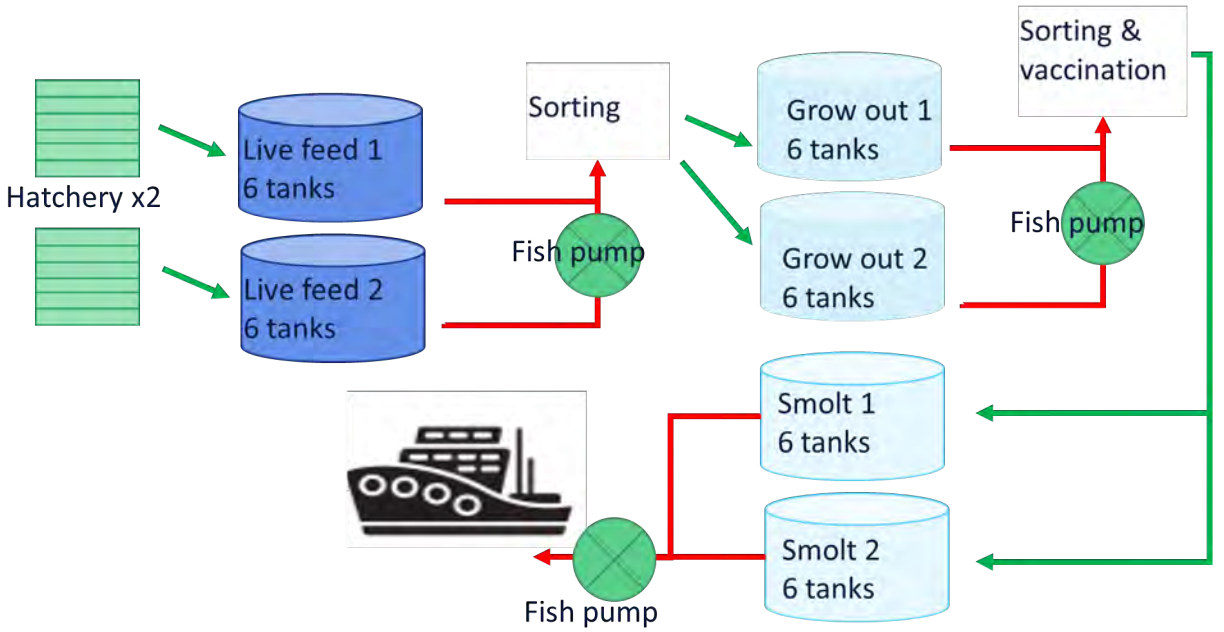


Illustration: Erik Sterud, Pure Salmon Tech

Production scale and water volume
Complex design – wash and disinfection?

Production intensity

Logistics

Time available affects implementation of optimal measures, and fallowing period

Thanks to!

Sonal Patel, Duncan Colquhoun, Simon Weli, Merete Sture Gåsvær, Miriam Furne, Saima Mohammad, Henriette Kvalvik

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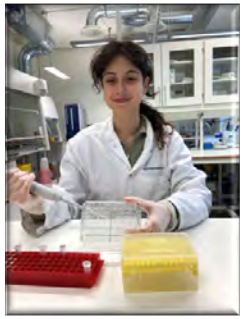

Marta Moutinho
Master student
University of Porto

Finance

FHF - 091792

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Scientifically ambitious, forward-looking and collaborative – for One Health

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