FHF #901783: **No-Gro**

"Fjerning av begroing på nøter med kontinuerlig børsting vs spyling: Sammenligning av effektivitet, fiskehelse, miljø og kostnader"

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FHF Dialogmøte - Beste praksis for not-strategi, Wednesday 3rd Sept, Gardermoen

No-Gro Team

Remora Robotics as

https://remorarobotics.no/

MOWI

Feltforsøk på Mowi Pinnen
(+ data fra Buksevika)

https://mowi.com/no/

NORCE

https://www.norceresearch.no/

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Aim

To compare the efficiency, impact on fish health and welfare, environmental consequences, and costs of continuous brushing versus flushing and other net cleaning methods for removing fouling on aquaculture nets

The secondary goals focus on detailed documentation and analysis of each method's environmental, biological, operational, and economic effects, supporting sustainable aquaculture practices

Field Experiment

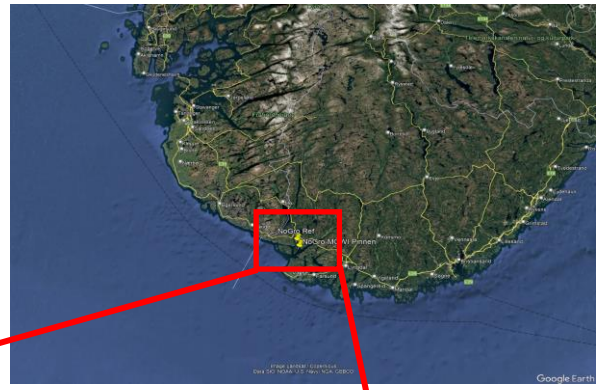
- **Cleaning efficiency** of the robot in a salmon farm based on photos of the net taken by the robot
- **Fish health**: stress (cortisol), gill damage (histology, eDNA microbiome), survival and growth of the salmon
- **Environment**: Microplastic in water samples taken during cleaning of the net with the robot and with pressure cleaning compared to a reference site

Field Testing at Pinnen

Sea-based fish farm located in Flekkefjord within the Agder region

Continuous brushing vs. flushing of growth on nets:

Equally effective? Equally good for salmon and the environment?



Comparing Net Cleaning Solutions

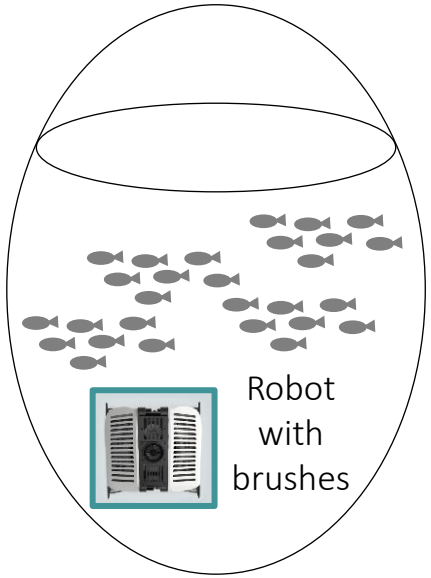
+ **Referanse-stasjon**

Continuous brushing with
Remora robot
(Cage 2)

Periodic flushing
Ryakva
(Cage 1)

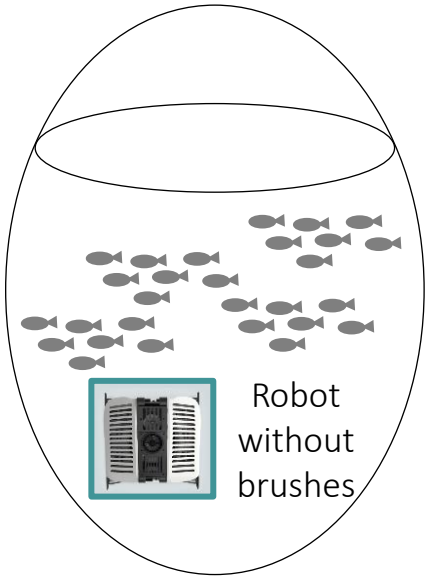
Environment: Amount of microplastics in water samples taken when nets are brushed or flushed compared to reference station

HDPE nets without impregnation
Smolt from the same batch



Fish Health:
Stress: cortisol in feces
Gill damage (histology)
Environment DNA microbiome gills

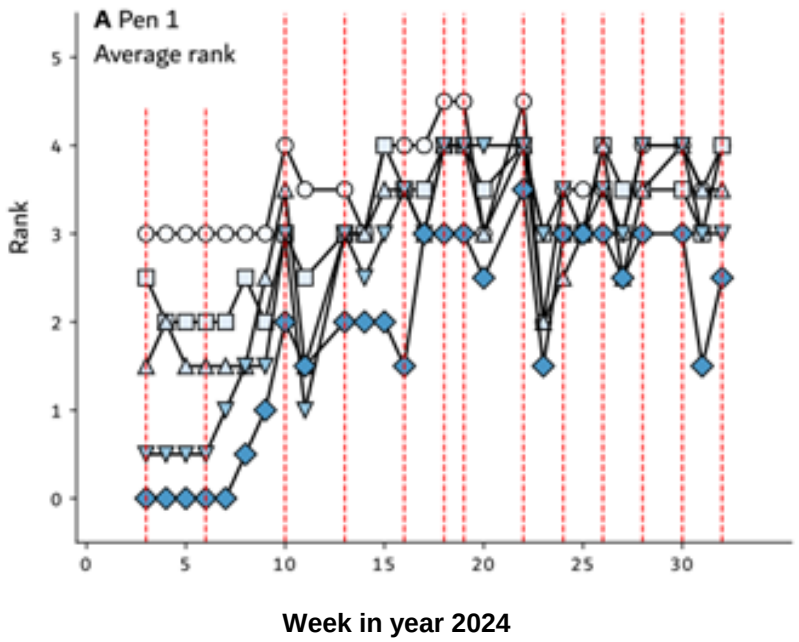
Cleaning efficiency:
Degree of fouling on the net documented with images taken by the robots



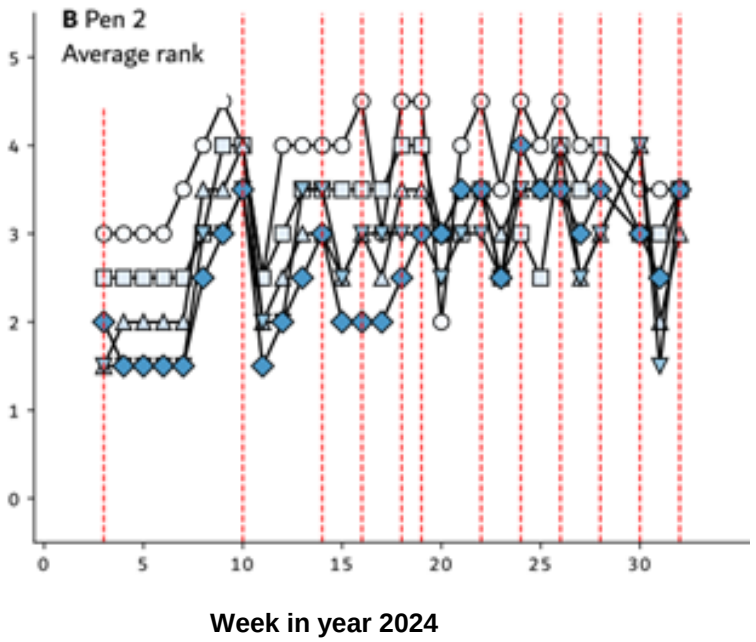
Cleaning Efficiency

The AOV with and without brushes took pictures of the nets and the amount of fouling on the nets was scored manually in the same way as Mowi do….

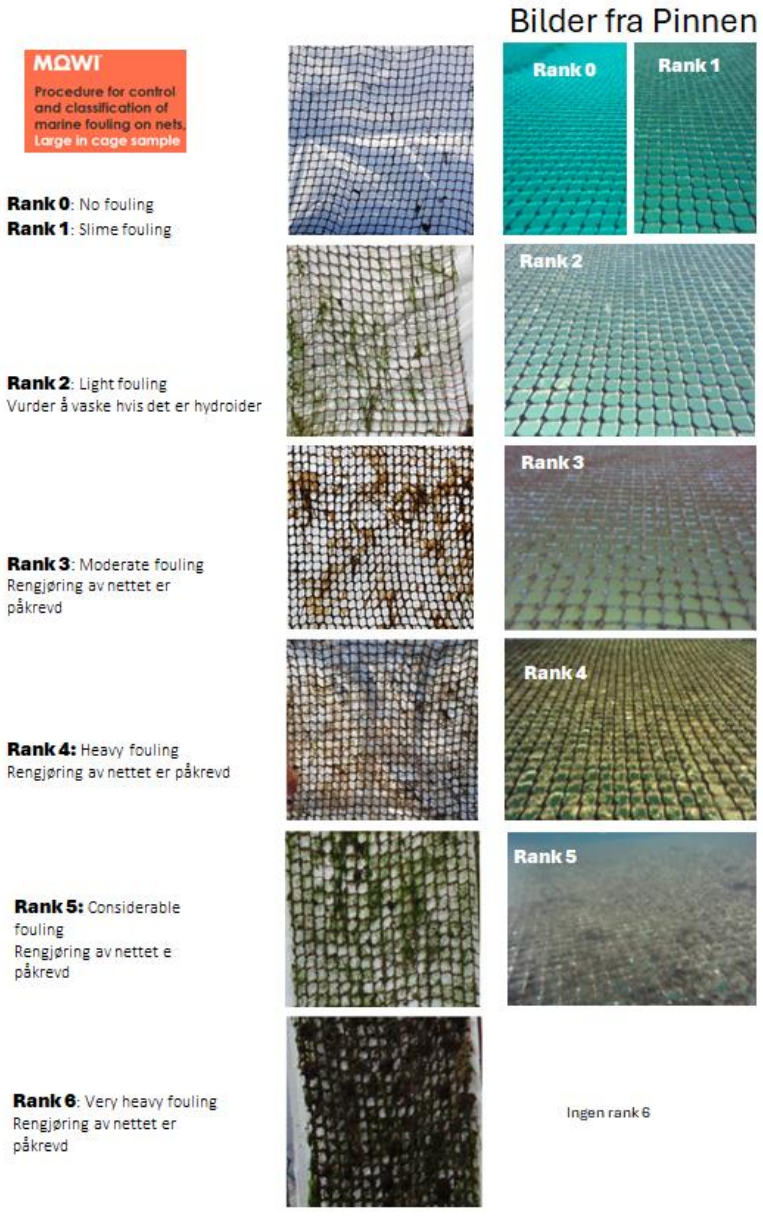
Net washing with periodic flushing



Net washing with AOV and periodic flushing



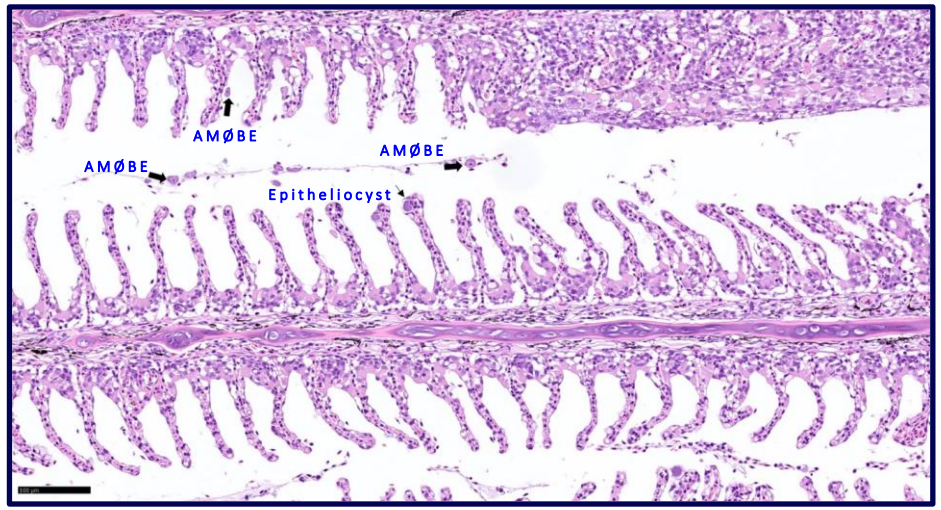
[……..] High-pressure flushing of the cages

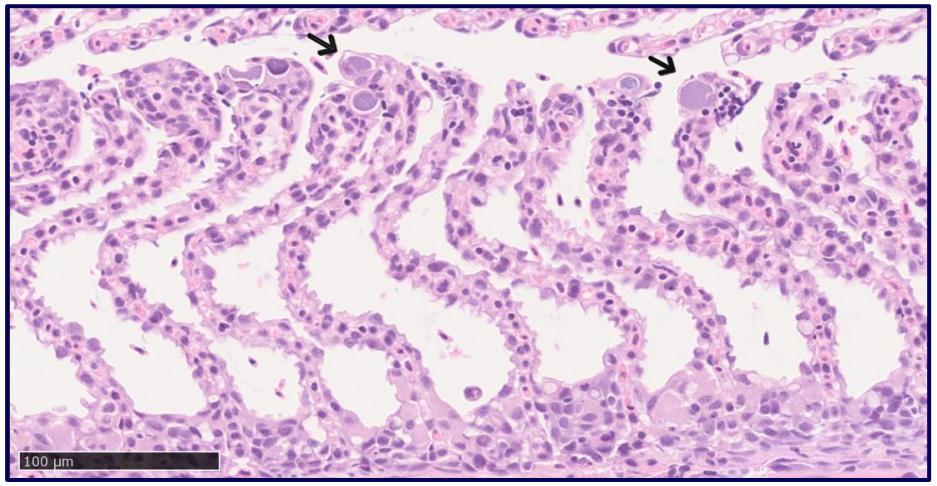


Fish Health

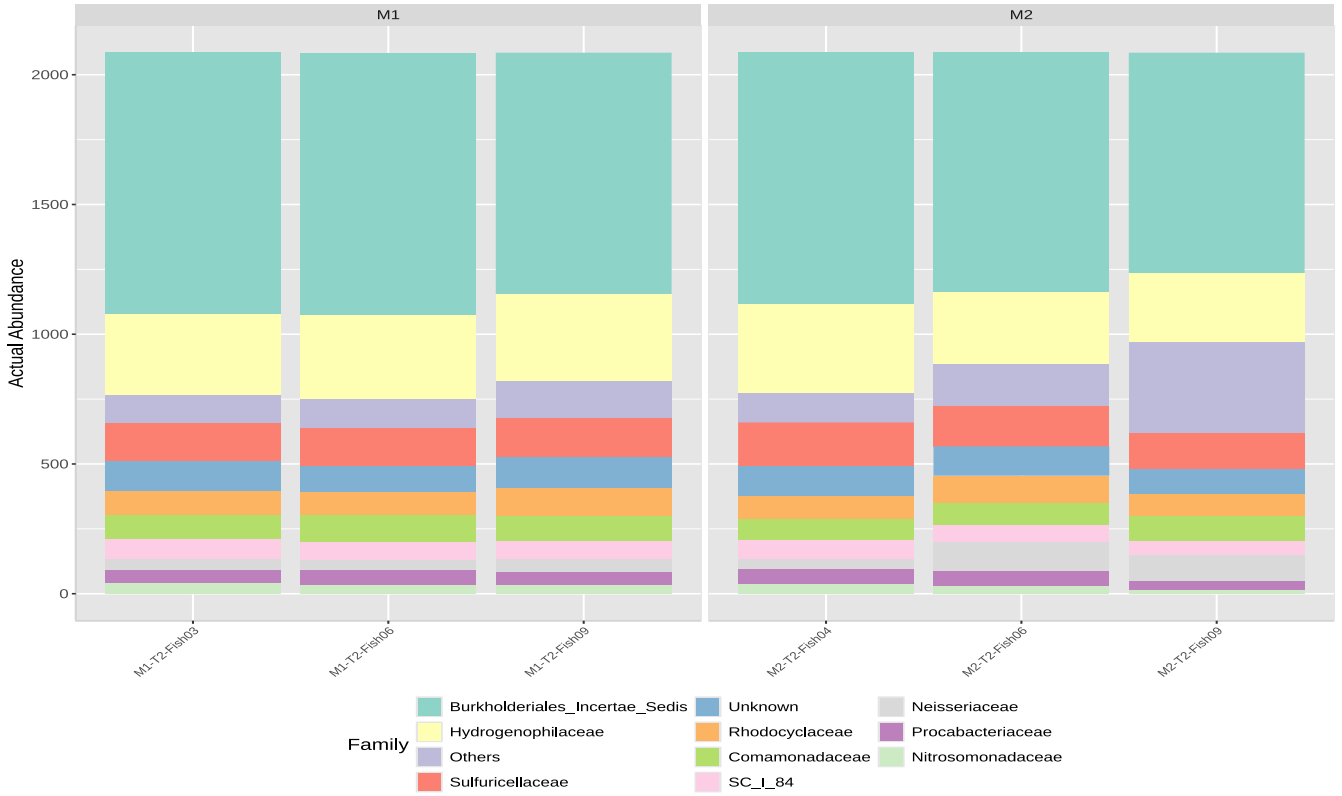
Cages with continuous brushing VS Periodic flushing

Veterinærinstituttet
Norwegian Veterinary Institute



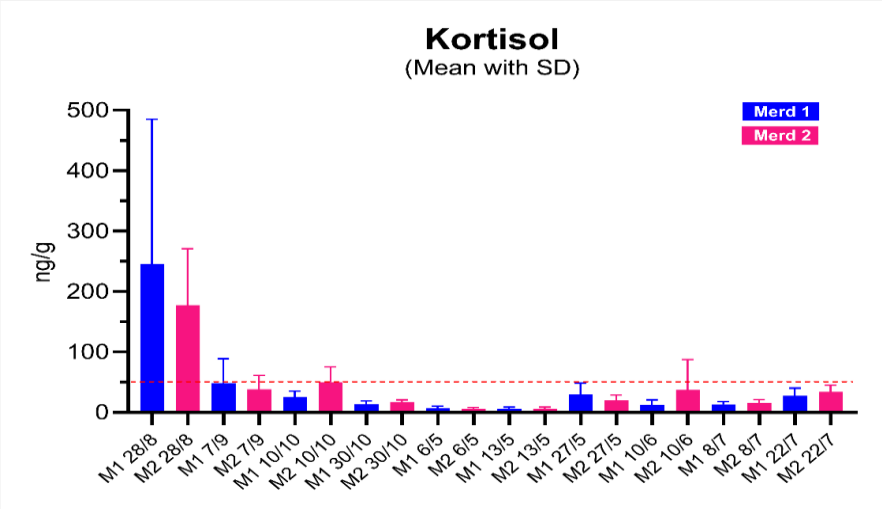


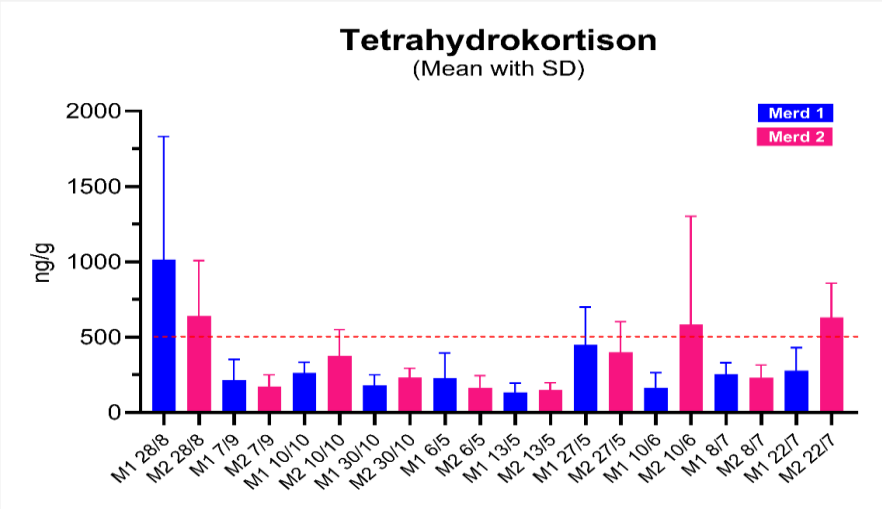
Analysis of gill-associated microbiomes



Gill pathology and gill-associated microbiomes: *no significant differences between the samples from the two cages*

Stress Markers in feces



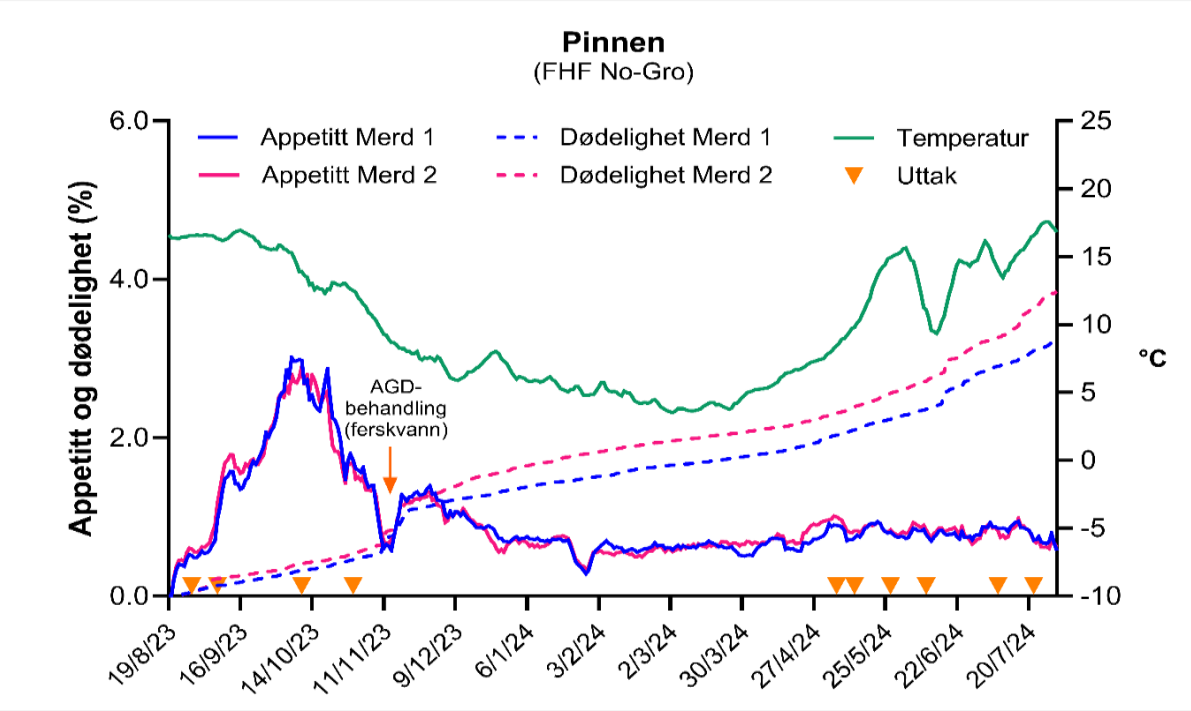


The fish were largely unstressed in both cages

Kun **spyling**

Børsting med Remora robot (og spyling da det trengtes)

Fish Health

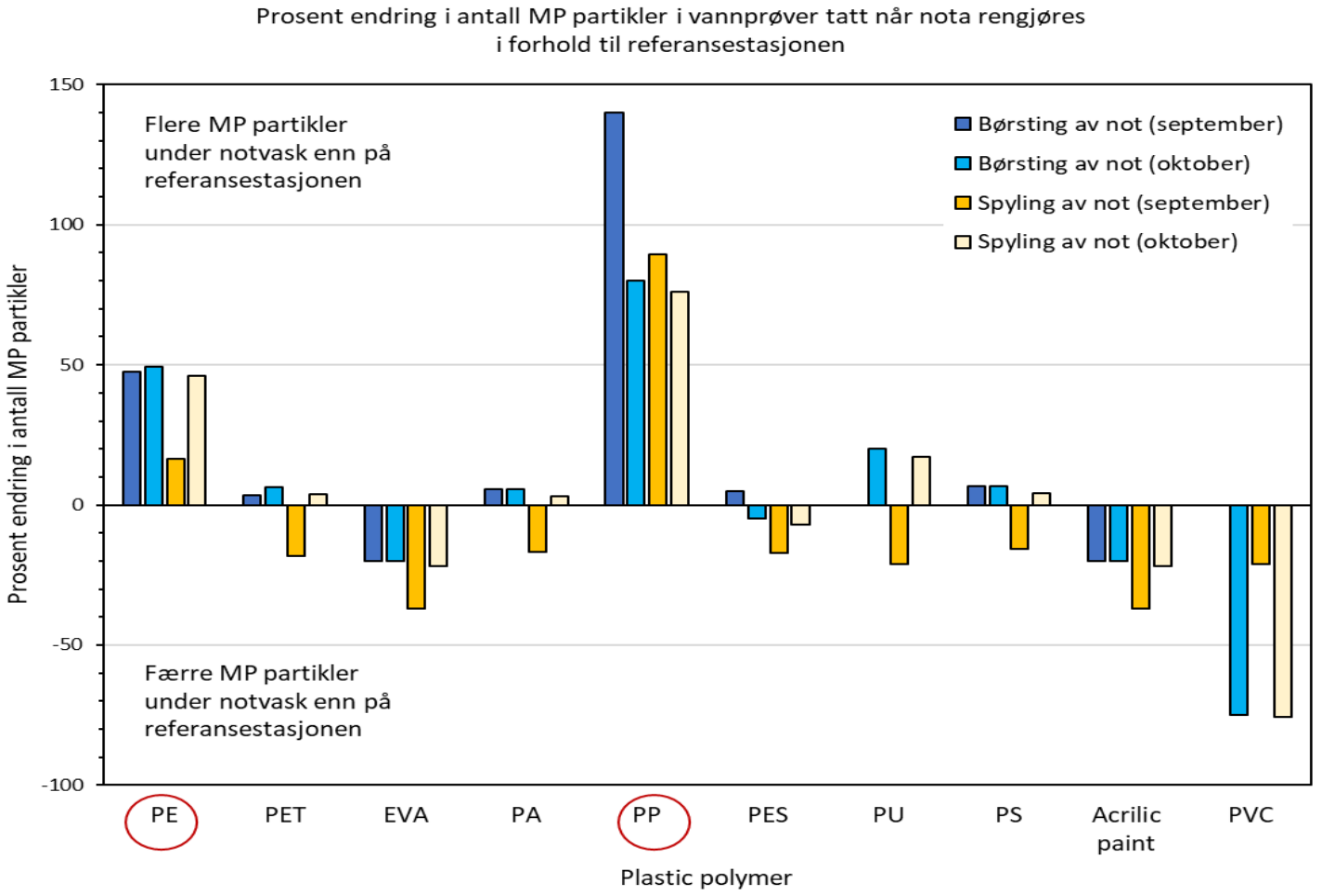


Oppsummering av produksjonsdata

Merd	Merd 1 (kun spyling)	Merd 2 (børsting)
Startvekt 19.08.2024	178 g	142
Vekt 29.07.2024	3 466 g	2 858 g
Antall fôringsdager	343	343
SGR (% daglig vekst)	**0,868**	**0,879**
Antall ved utsett	197 004	197 380
Antall dødfisk	6 135	7 309
Overlevelses %	**96,8%**	**96,2%**

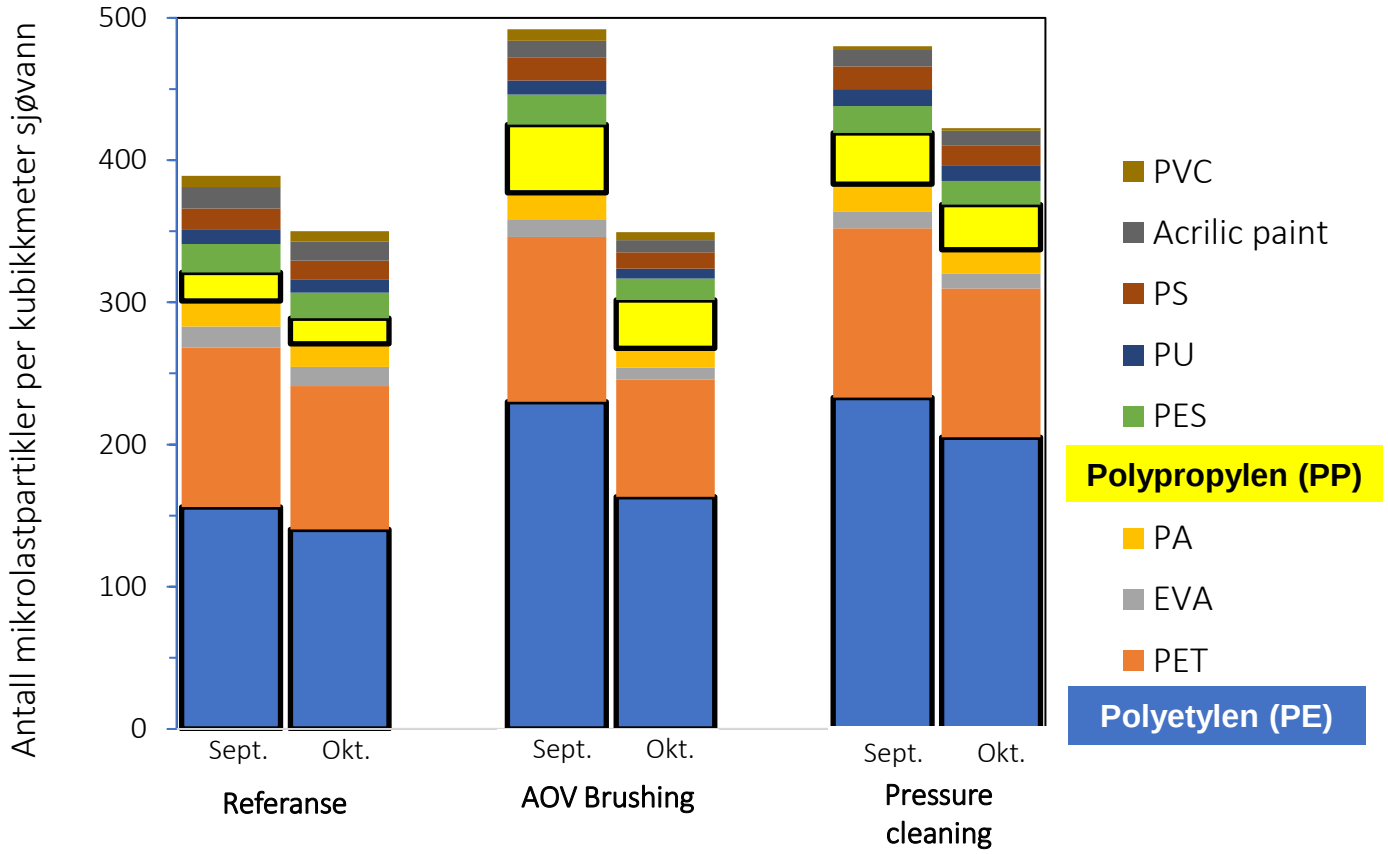
The fish health in the two cages was equally good!

Microplastics occurrence in water



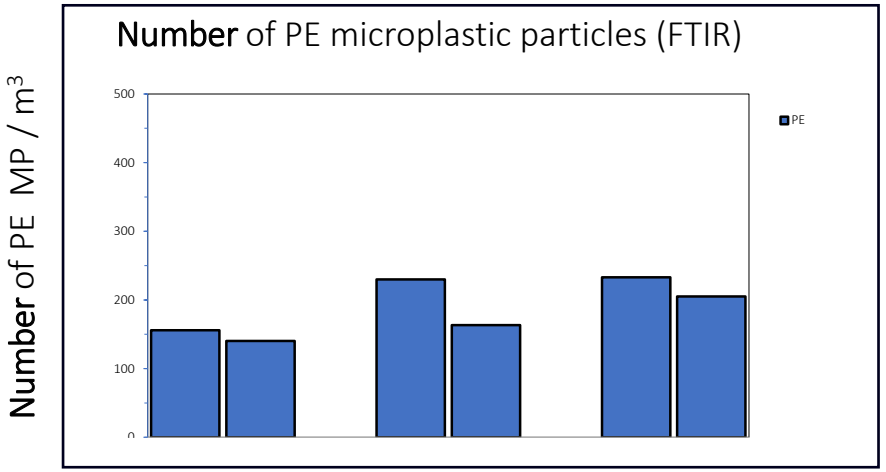
Microplastics occurrence in water

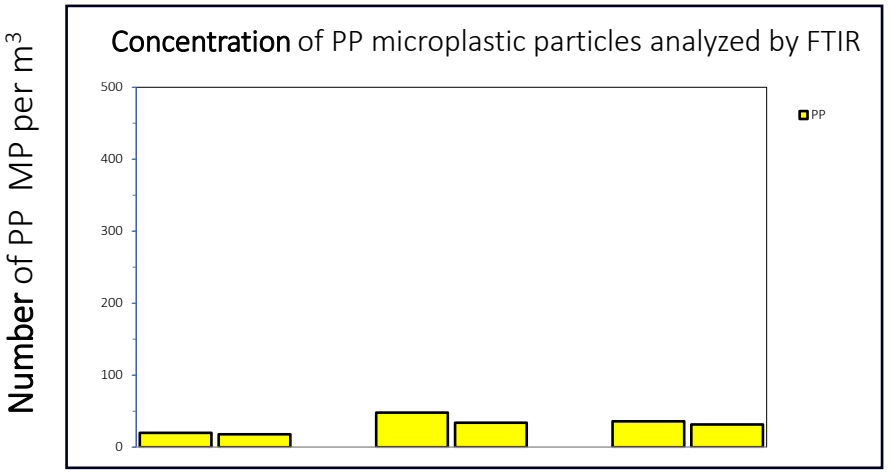
MPs in seawater filtered when the cages were flushed or brushed compared to a reference station

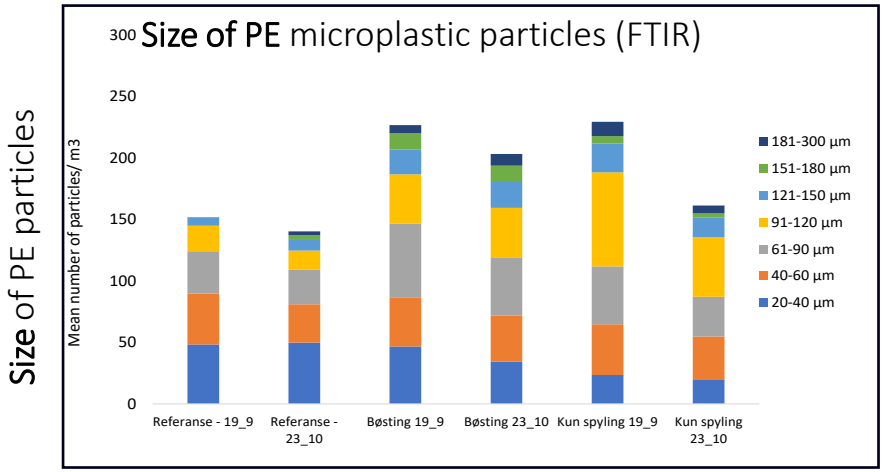


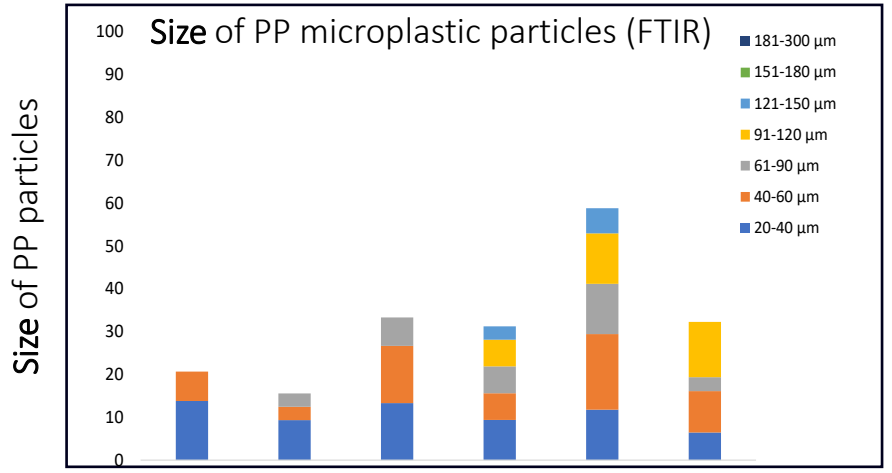
- Some more MP on the production site than the reference
- Plastic fragments are presumably transported away from the plant by the ocean currents
- No clear difference between the samples taken next to the two pens during flushing and brushing
- We have done a lab experiment to check how much plastic is released when nets are brushed and rinsed under controlled conditions to get a better answer.

Microplastics occurrence in water









Reference **AOV Brushing** **Pressure Cleaning**

19/9-23 23/10-23 9/9-23 23/10-23 19/9-23 23/10-23

Reference **AOV Brushing** **Pressure Cleaning**

19/9-23 23/10-23 19/9-23 23/10-23 19/9-23 23/10-23

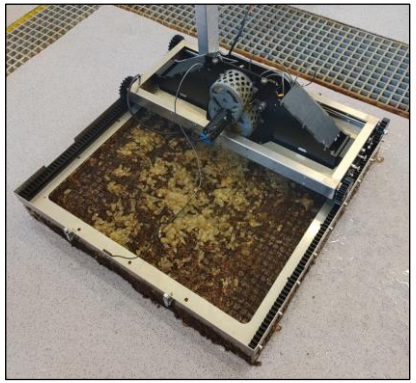
Laboratorial Experiments

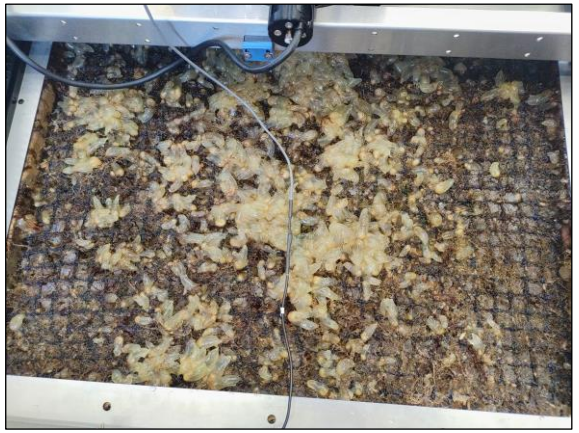
Testing the cleaning efficiency of two types of brushes compared to high pressure washing on two types of net, nylon and HDPE analysing the MPs and organic material removed.

5 replicates/treatment

300 L seawater volume / treatment

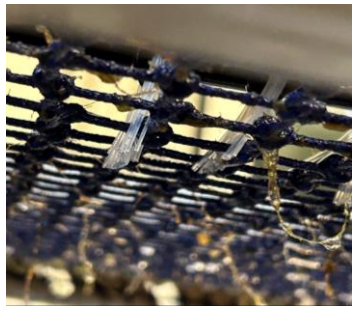
Entire water volume collected and analysed

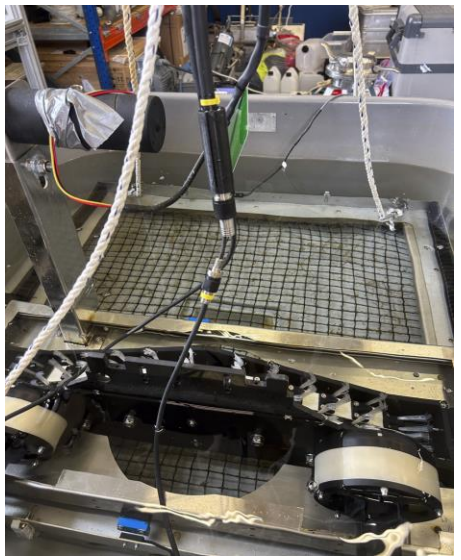




Lab based experiments

Compared amount of MPs and organic matter released during brushing and flushing of HDPE and nylon nets with natural fouling.

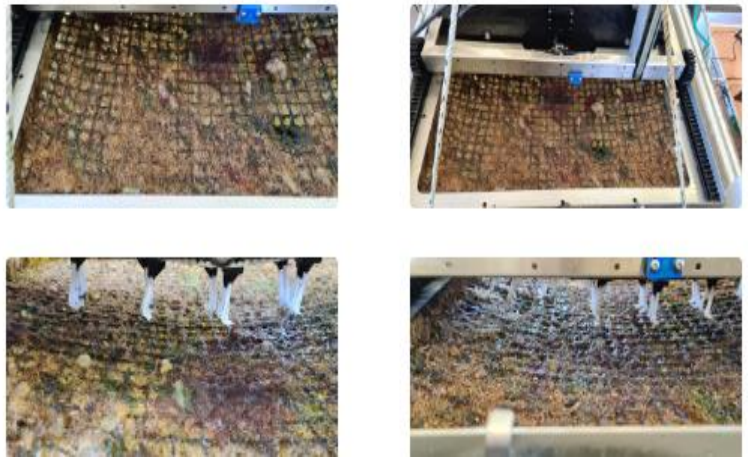




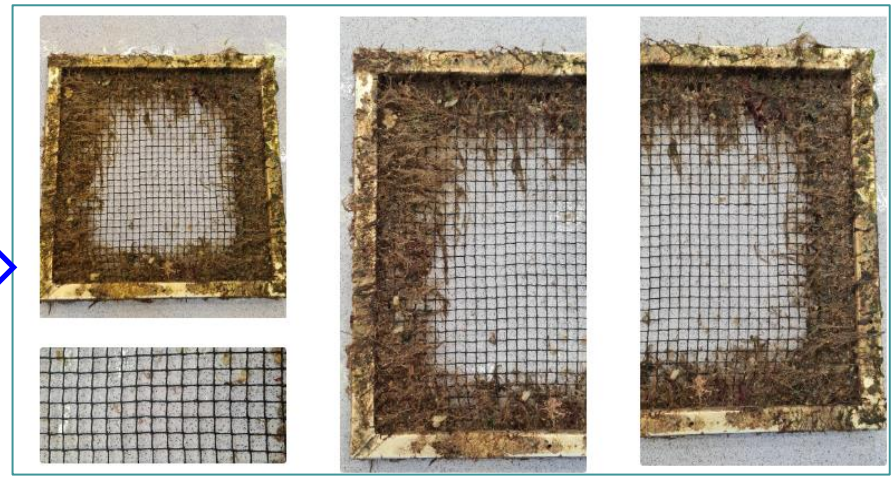
The degree of fouling on the net assessed from photos taken at the start (T0) and after 15 and 30 min brushing/flushing

The brushing AOV operated at a speed of ≈ 4.8 seconds per transition (30 transitions in total). Set up replicated manually by pressure washing (the same number of transitions and duration)

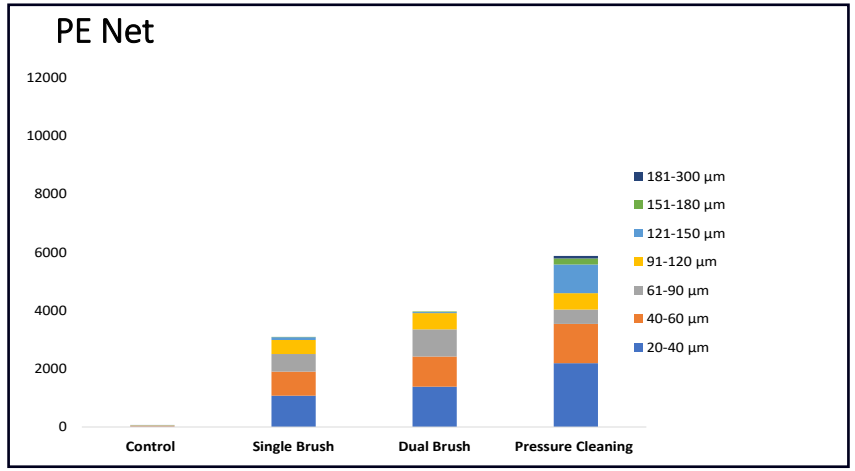
Before brushing

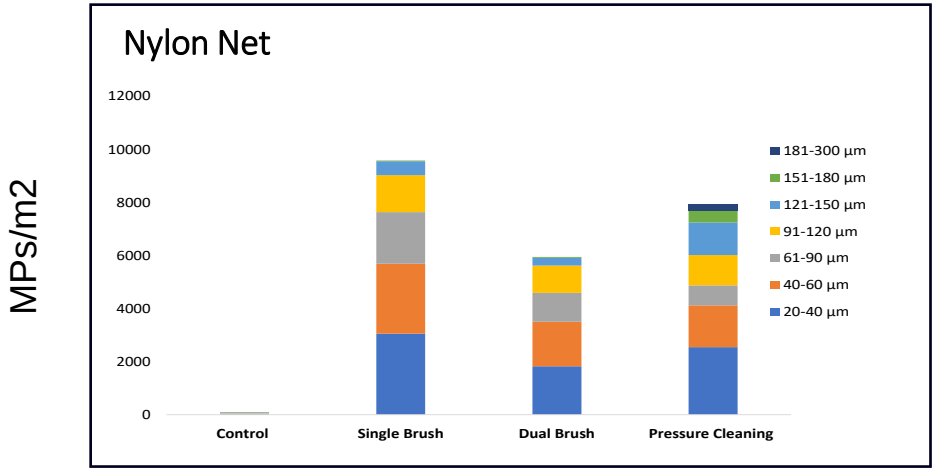


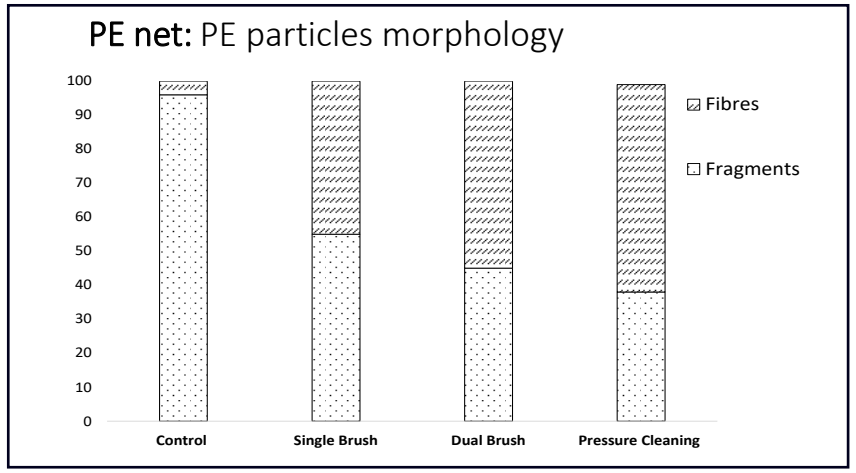
After brushing

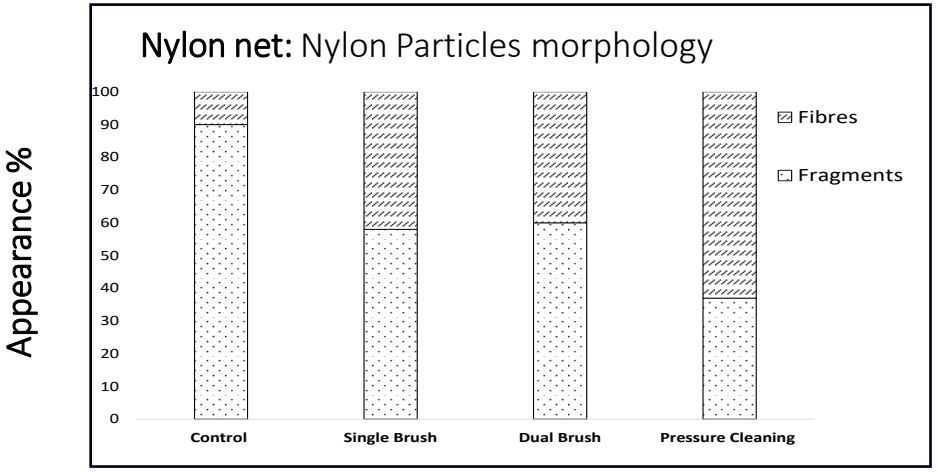


Lab testing: microplastics occurrence in water









Lab Testing: main outcomes

Polymer type dependent release

→ Larger release from NY nets than from PE nets, independent to the used cleaning technology

→ Technology and material depended particles' size distribution observed

Cleaning type dependent release

→ Pressure cleaning releases tendentially larger sizes particles and with more elongated forms (fibres)

→ PE: relatively higher release from high pressure cleaning than from brushing technology

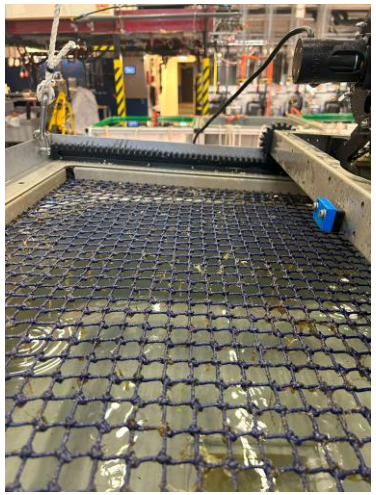
→ PE & NY: Bushing oriented technology tend to release more fragments than fibres

Knowledge gaps

→ Examine how combinations of net type/material, weathering factors, fouling level, polymer age, cleaning technologies, and coating materials influence microplastic emissions to elucidate the underlying factors on larger but still lab-based dimension.

➡ Adding a time and geographical scale to the picture

→ Assist in the development of current cleaning technologies by identifying combinations of technical parameters that simultaneously maximize efficiency, reduce maintenance costs, and minimize the environmental footprint of aquaculture operations



Thank you!