Senter for forskningsdrevet innovasjon
Norges forskningsråd

Oppsummering av

CtrlAQUA SFI

Åsa Maria Espmark

Nofima

CtrlAQUA

Mål for CtrlAQUA SFI

CtrlAQUA skal utvikle teknologiske og biologiske innovasjoner som vil gjøre lukkede anlegg til en pålitelig og økonomisk levedyktig teknologi. Hovedfokus er innovasjoner for de strategiske periodene i laksens produksjonssyklus, slik som postsmoltfasen

RAS on land

S-CCS in sea

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21 CtrlAQUA SFI partners!

Host institution:

- Nofima

R&D-partners:

- Norce
- University of Bergen
- Norwegian University of Science and Technology
- The Freshwater Institute, WV, U.S.
- University of Gothenburg, Sverige
- University of South-East Norway

User partners:

Suppliers of Technology:

- Pure Salmon Kaldnes
- Create View
- Aquafarm Equipment
- FishGLOBE
- Fiizk
- Atlantium

Farmers:

- Mowi
- Cermaq
- Grieg SeaFood
- Lerøy SeaFood Group
- Bremnes Seashore
- Nekton

Biotechnology companies:

- Pharmaq
- Pharmaq Analytiq

- Delvis finansiert av NFR)
- 8 år (2015 – 2023)

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CtrlAQUA skulle bidra med kunnskap for å…..

Sikre at postsmolt blir robust og får god helse og velferd

- Vannkvalitet (H_2S, VK parametere, hastighet….)
- Hindre kjønnsmodning
- God karhydraulik
- Dokumentere velferd i SCCS

Forebygge fiskehelse

- Barriærefunksjoner
- Hindre nefrokalsinose
- SCCS og fare for smitte
- Biosikkerhet (desinfisering, behandling av inntaksvann)

Videreutvikle teknologi og sikre miljø

- Optimale teknologiske løsninger
- Teknologi på fisken sine premisser
- Vannbehandling
- Biofilter
- Energioptimalisering

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Oppsummering av CtrlAQUA på 15 minutter!?

Ca 13 CtrlAQUA prosjekter per
10 assosierte prosjekter
15 PhD studenter
55 MSc studenter

- Innovasjoner
- Faktaark
- Hvilke erfaringer sitter vi igjen med

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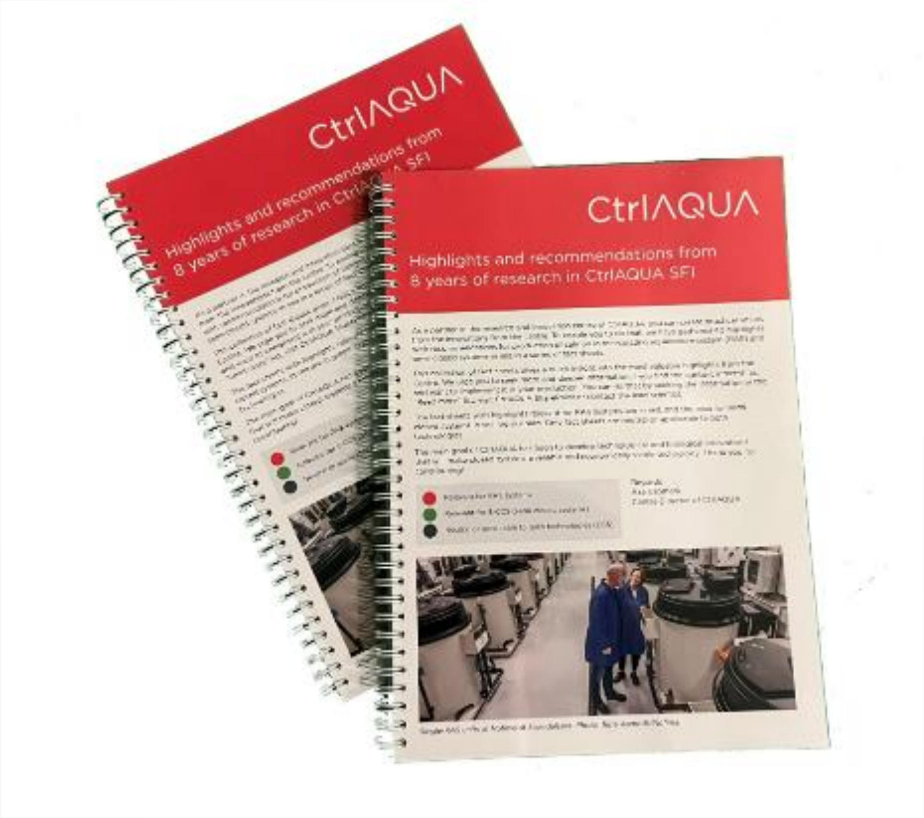
Faktaark – oppsummering av sentrale resultater



- 43 faktaark - høydepunkter fra 8 års forskning på lukkede oppdrettssystemer
- Samarbeid med industripartnerne
- Klare til implementering

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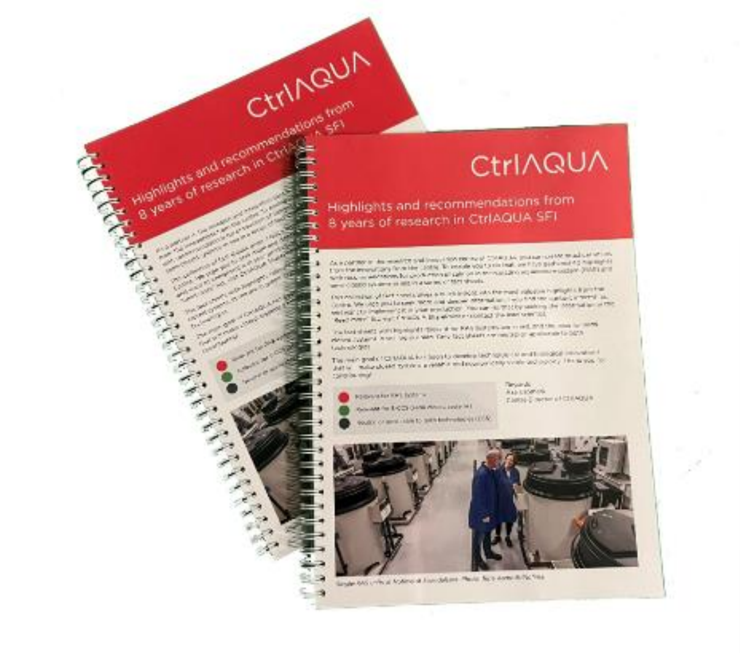
Faktaark – oppsummering av sentrale resultater



Oppbyggingen er gjort sammen med næringsaktørene

Hvert faktaark
- Kort beskrivelse av resultat
- Anbefalinger
- Kontaktperson
- Anbefalt videre lesing for mer informasjon

- Delt inn etter relevans
  - Rød: RAS
  - Grønn: S-CCS
  - Grå: nøytral eller relevant for både RAS og S-CCS

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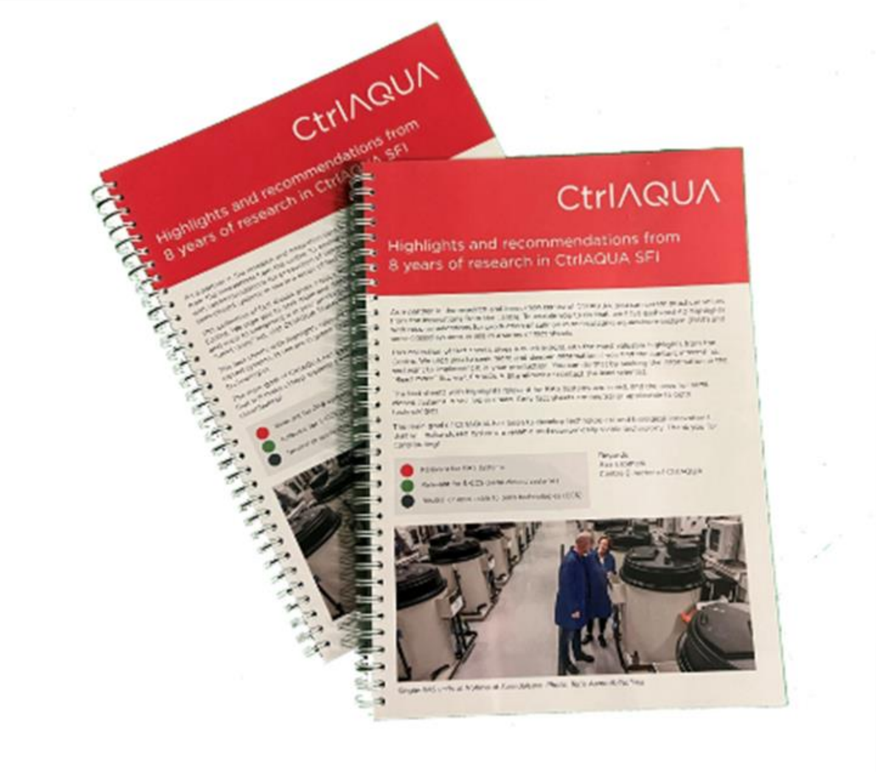
Faktaark – tilgang

www.ctrlaqua.no
www.nofima.no



23 faktaark

Relevant for RAS-system

10 faktaark

Relevant for semi-lukkede systemer i sjø

10 faktaark

Nøytral eller anvendelig for begge teknologier

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Faktaark – eksempel RAS

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PROJECT: BENCHMARK
SYSTEM: RAS
PARTNERS: Nofima, NORCE, University of Bergen, Pharmaq Analytiq, Pharmaq, Bremnes Seashore, Grieg Seafood, Cermaq Norway, Mowi
CONTACT: Trine Ytrestøyl (trine.ytrestoyl@nofima.no)

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The effect of timing and length of a w ter signal in RAS and size at transfer c post-smolt performance in seawater

RESEARCH QUESTION:

In Benchmark 1, the best performing group was the 100 g smolt transferred in Augu the optimum smolt window, 360 daydegrees after the end of the winter signal. The that were transferred later at a bigger size had lower growth in seawater. The quest was whether delaying and prolonging the winter signal in RAS could improve seawa performance of Atlantic salmon transferred to seawater at a larger size.

DURATION: 2021-2023

FISH SIZE TESTED: 50-3600 g

SALINITY TESTED: Fresh water and brackish water (12 ppt and 0 ppt)

HIGHLIGHTS:

- 24 h light improved growth in RAS whereas no positive effect of using brackish water was found.
- 24 h light in RAS led to reduced growth rate in seawater.
- Salinity in RAS did not affect growth in seawater.
- Fish transferred in September that were produced with early winter had the highest TGC (thermal growth coefficient) in seawater (3.3) and were largest at slaughter. Fish on 24 h light in RAS were slightly bigger at slaughter (3681 g) than fish given an early winter signal (3571 g).
- Mean bodyweight at slaughter for fish transferred in October and January were 3054 and 3058 g and TGCs were 3.0 and 2.4 respectively.
- Photoperiod and salinity in RAS c significantly affect survival in sea
- The fish were infected with *Morite viscosa* and Tenacibaculum which mortality due to winter ulcers fro February until April.
- Fish transferred in September wa affected by winter ulcers and mo until the end of April was 5% for t group. Fish transferred in Octobe January suffered mortalities of ar 30% until late April.
- The fish was diagnosed with HSM July and delousing in July and Se resulted in 15-20% mortality that related to size at transfer to sea.
- A 6-week winter signal in RAS and transfer at 850 g increased male maturation in seawater.

RECOMMENDATION:

- These are preliminary data as not all results are processed.
- It is recommended to transfer fish at a

should be used with caution if the smolts

The factsheet is ready for implementation, but with the note that the testing has not been done for all industrial relevant conditions.

Protocol in RAS	Transfer time	Weight at transfer (g)	Final weight (g)	TGC in seawater	Maturation (% of dead males)
NW-BW	13th of Sept	185	3699 ****	3,2 ****	0 ****
NW-FW	13th of Sept	190	3663 ****	3,2 ****	0 ****
EW-FW	13th of Sept	151	3600 ****	3,3 ****	0 ****
EW-BW	13th of Sept	146	3546 ****	3,3 ****	0 ****
LW-BW	24th of Jan	901	3231 ***	2,4 *	7 ***
LW-FW	29th of Oct	341	3212 ***	3,3 ****	5 ****
EW-FW	24th of Jan	840	3110 **	2,4 *	23 *
NW-FW	29th of Oct	361	3108 **	2,9 ***	2 ****
LW-FW	24th of Jan	900	3102 **	2,3 *	26 *
LW-BW	29th of Oct	319	3091 **	3,0 ***	2 ****
LLW-BW	24th of Jan	725	3052 **	2,6 **	2 ****
EW-BW	24th of Jan	892	3037 **	2,3 *	21 *
NW-BW	24th of Jan	937	3000 *	2,2 *	3 ****
NW-BW	29th of Oct	351	2990 *	2,8 ***	7 ***
NW-FW	24th of Jan	920	2982 *	2,2 *	8 ***
EW-BW	29th of Oct	270	2963 *	3,1 ****	0 ****
EW-FW	29th of Oct	280	2963 *	3,0 ***	8 ***
LLW-FW	24th of Jan	730	2954 *	2,5 **	11 **

NW = No winter
EW= Early winter
LW= Late winter
LLW = Late long winter

	weight	TGC	maturation
****	3400-	3.1-3.3	0-5%
***	3200-3300	2.8-3.0	5-10%
**	3100-3000	2.5-2.7	10-15%
*	2900-3000	2.2-2.4	15-26%

Growth and maturation in seawater for the different protocols, ranged by final weight in November 2022.

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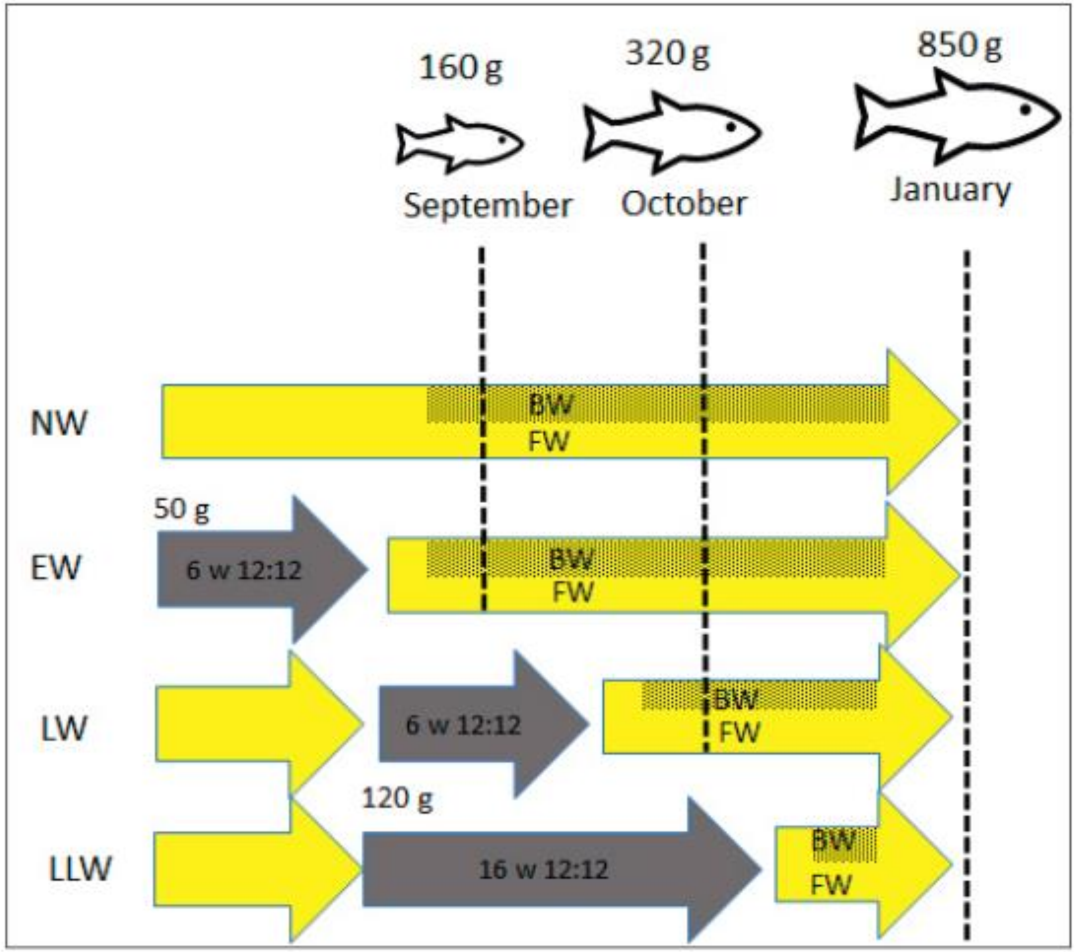
Faktaark – eksempel RAS



Photoperiods in RAS and mean bodyweight at transfer to seawater pens at Gifas. The fish were exposed to 4 photoperiods in RAS, continuous 24 h light (NW), an early winter signal (EW, 6 weeks 12 h L:D from 50 g), a late 6-weeks winter signal (LW, from 120 g) or a long winter signal (LLW, 16 weeks from 120 g). All photoperiod treatments were replicated in freshwater (FW) and in brackish water RAS (12 ppt) until seawater transfer at in September, October and January. Seawater survival and growth performance was compared in the different treatments until slaughter in November 2022.

Faktaark – eksempel S-CCS

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Faktaark – eksempel nøytral, eller både RAS og S-CCS

PROJECT: BARRIER
PARTNERS: Nofima, CreateView
CONTACT: Christian Karlsen (christian.karlsen@nofima.no)

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Wound types and regeneration

A major step towards successful production of Atlantic salmon in closed and semi-closed containment system (CCS, S-CCS) is knowledge about how these systems affect the diversity, prevalence and load of microparasites (viruses, bacteria, protozoan parasites, and fungi) in comparison with existing knowledge from open production systems. Will change in the culture system (e.g. S-CCS with water intake at large depths) lead to introduction of new microparasites not found in open production systems?

HYPOTHESIS:

The healing progression of physical or mechanical induced wounds depends on the wound's severity and type.

DURATION: 2021 - 2022

FISH SIZE TESTED: 400-600 g

SALINITY TESTED: Salt water

WATER TEMPERATURE: 10 °C

HIGHLIGHTS:

Wound healing progression after 5 weeks.

Healing progression between wound types is shown in Figure 1.

- Scale loss initiates re-epithelialization with rapid migrating skin keratocyte cells that cover and seal the surface after hours restoring the barrier function. The blood osmotic balance is restored after less than 2 days when fish suffer a skin area scale loss of -10%, as shown in Figure 1. Healing of the tissue takes longer time. By week 5 at 10 °C, appearance is similar to the control with developed scales and structured epithelial layer with a high number of mucosal cells.
- Superficial wounds (scales are scraped off, also removing the outer skin structures completely, while leaving the dermis intact) have a longer recovery time. After 5 weeks, a gel like substrate is still filling the wound. Epidermis is sealed with a thick layer of keratocytes. Skin tissue layers are regenerating, display pigmentation, and starts developing scales. The epidermal surface has a high number of mucosal cells.
- Deep wounds (induced by punch biopsy tool) are after 5 weeks noticeable with dark coloration at the wound edges on the dorsal side. Ventral wounds appear more contracted. Restructuring of the tissue is on-going but the thickness of the epidermal layer is dominating. The epidermal layer has a high number of mucosal cells.

RECOMMENDATION:

- Knowing the healing progression of different wound types when injuries occur is valuable. This can be used to estimate a time frame for healing, if the tissue recovers and restore, or if activities such as e.g., handling or necessary treatments may increase the risk of recurrence and add to further damage.
- Wound healing progression depends on the severity of damage (Figure 1). After 5 weeks at 10 °C, scale loss area was in the final remodelling stage, superficial wounds were closed but only starting to develop scales, and deep wounds were still in inflammation with active tissue formation.
- It is expected that at higher temperatures healing progression is faster, while lower temperatures lengthen the healing time.

The factsheet is ready for implementation, but with the note that the testing has not been done for all industrial relevant conditions.

READ MORE:

- Deliverable D3.1/BARRIER/2022

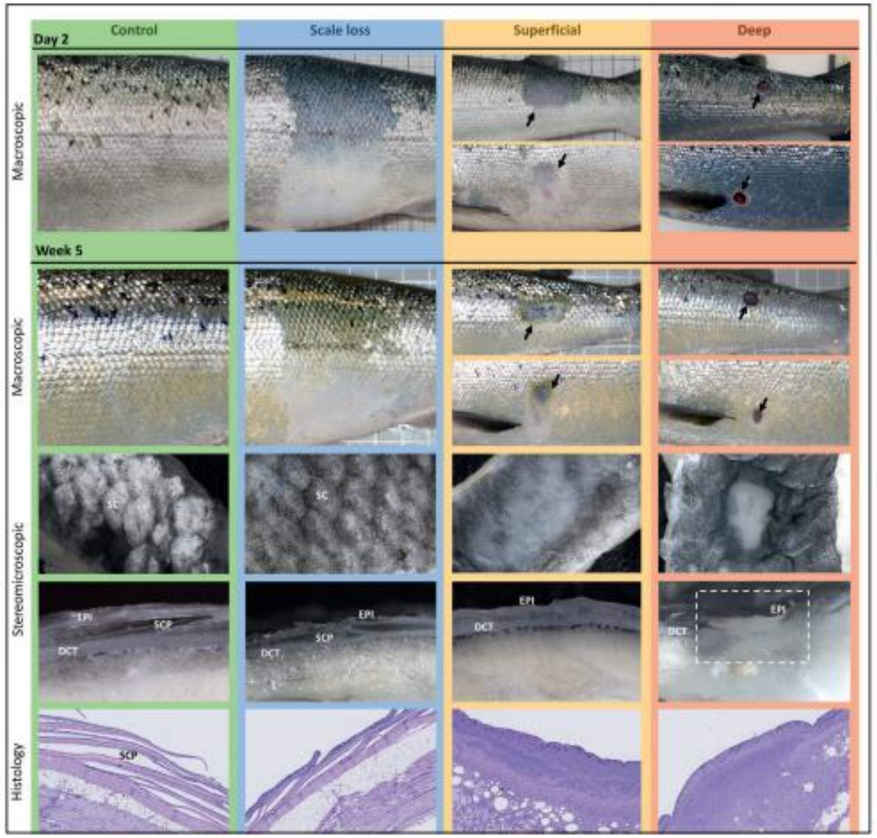

Figure 1. Wound healing progression, in salt water at 10 °C, between wound types shown by visual appearance, close up of the surface, by vertical sagittal cut followed by histological sections of the different wound types. The general wound healing cascade includes re-epithelialization, inflammation, granulation tissue formation and tissue remodeling.

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Hvilke erfaringer sitter vi igjen med....bortsett fra at vi har skapt mye ny kunnskap

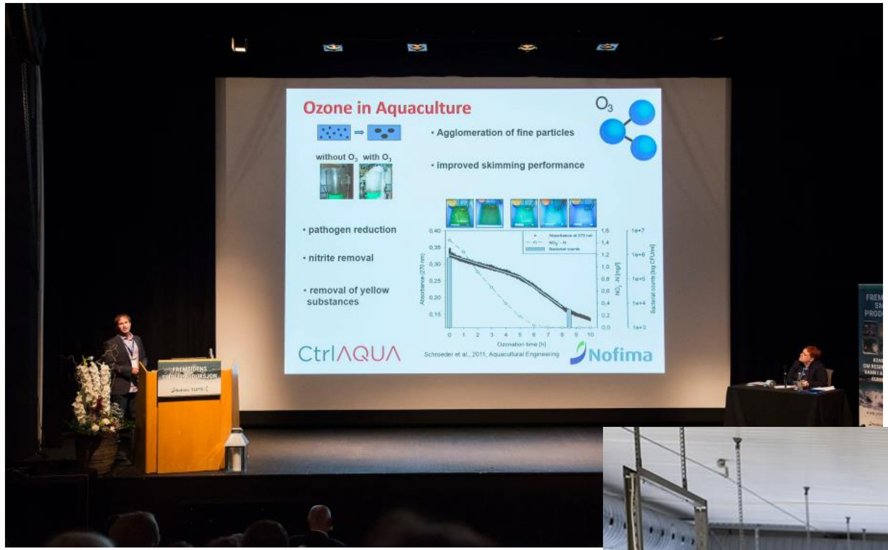
Konsortium

- Engasjerte pga relevant tematikk
- Mye deling av erfaring og kunnskap

8 år

- Nødvendig for å få signifikant løft av tema
- Kontinuitet skaper resultater og engasjement
- SFI`er er fleksible og tar hensyn til at verden endrer seg på 8 år
- God mulighet til å bygge kompetanse med rekruttering

CtrlAQUA på Fremtidens smoltproduksjon



Takk for oppmerksomheten!!

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