

Use of bath probiotics for production of Atlantic salmon smolt

Kira Saloniuss ^{1*}, Camilla Skagen-Sandvik¹, Cristopher Nilsson¹, Aud Kari Fauske^{1,2}, Øystein Klakegg^{1,2}, Karoline Skaar Amthor ¹, Henning Sørum ²

¹ Previwo AS

² NMBU (Norwegian University of Life Sciences)

A novel approach to improved fish health and welfare

- **Use of beneficial bacteria**
- **Static or transient bath**
- **Enhance salmon growth by**
 - Inhibiting
 - Outcompeting
 - Signaling
 - Or displacing

malevolent bacteria posing a threat to fish health.

The results of this research and development may

- **help to reduce the use of chemical drugs,**
- **increase fish health and growth**
- **reduce costs in aquaculture.**

Norwegian Regulatory Frame

- Microbial products for use in the environment are declared in a product dossier to the Norwegian Environment (Miljø) Agency
- Aquatic bath applications of probiotics are not regulated by the medicines authority (SLV) or food safety authority (Mattilsynet)

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|---|--|
|  | |
| Regulation on the labeling and labeling of microbiological products with an application that leads to the introduction to the external environment | |
| Date | FOR-1998-01-22-93 |
| Ministry | Ministry of Climate and Environment |
| Published | Avd In 1998 181 (Comments) |
| Commencement | 02/01/1998 |
| Last changed | FOR-2018-08-27-1273 from 01.10.2018 |
| Applies to | Norway |
| Legal | LOV-1976-06-11-79-§4 , LOV-1976-06-11-79-§8 , FOR-1990-09-07-730 |
| Corrected | 02.03.2017 (comments on § 4) |

First product with commercial application

- Patent granted Norwegian patent authority (grant number 342578, 2018.06.18), PCT application 20171067169
- Tradename Stembiont™
- Bath or dip application of probiotic bacteria to Atlantic salmon pre-smolt / smolt
- Based on the research of Dr. Henning Sørum and developed together with and within the industry



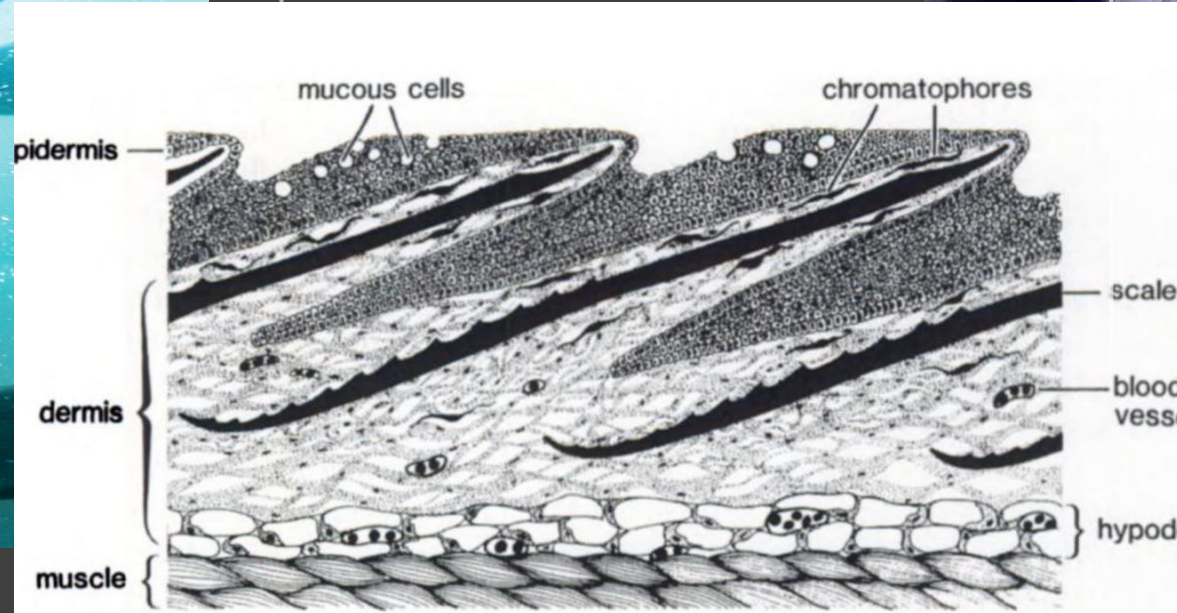
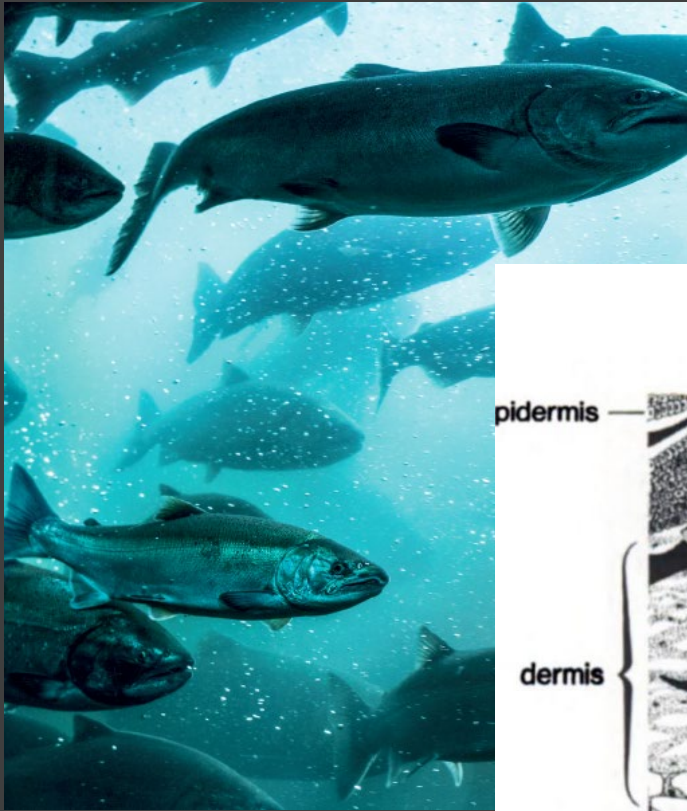
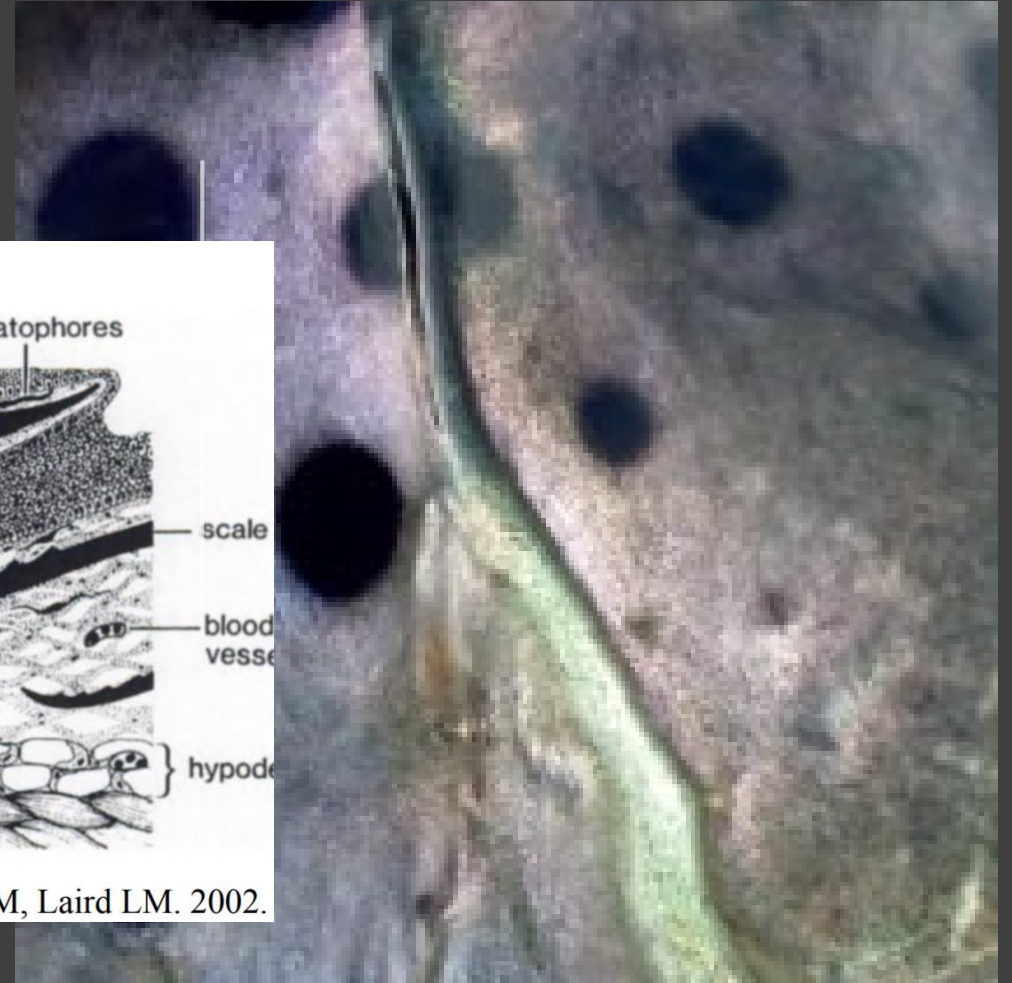


Figure 1: diagram of a longitudinal section of the skin. (Stead SM, Laird LM. 2002.



Skin of salmon is porous and in constant contact and exchange with the environment

Skin and mucus host a diverse microbial community in healthy fish



The Skin-Mucus Microbial Community of Farmed Atlantic Salmon (*Salmo salar*)

Giusi Minniti¹, Live Haldal Hagen¹, Davide Porcellato¹, Sven Martin Jørgensen², Phillip B. Pope^{1*} and Gustav Vaaje-Kolstad^{1*}

¹ Faculty of Chemistry, Biotechnology and Food Science, Norwegian University of Life Sciences (NMBU), Ås, Norway,

² Nofima AS, Norwegian Institute of Food, Fisheries and Aquaculture Research, Ås, Norway



The microbial community is under influence

- Stress
- Handling
- Treatments
- Water quality
- Presence of naturally occurring beneficial and pathogenic bacteria
- Environment
- Bacteria are a major component of the aqueous environment
- Hygiene and water disinfection reduce bacteria (good and bad)

Bacteria (good and bad) are readily taken up in the blood



journal homepage: www.elsevier.com/locate/aqua-online

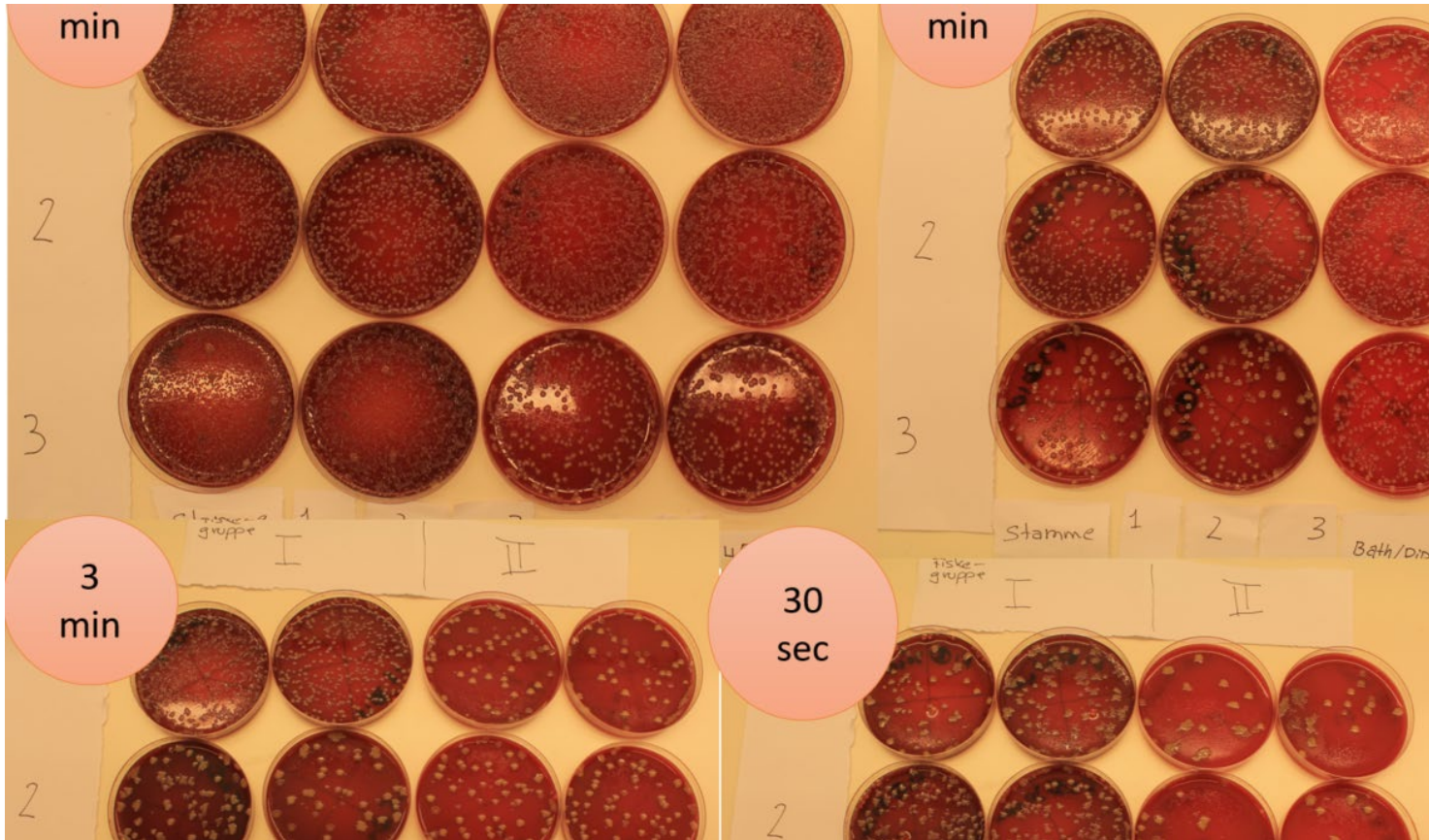
A novel in vivo model for rapid evaluation of *Aliivibrio salmonicida* infectivity in Atlantic salmon

Alexander Kashulin^{a,*}, Henning Sørum^{b,1}

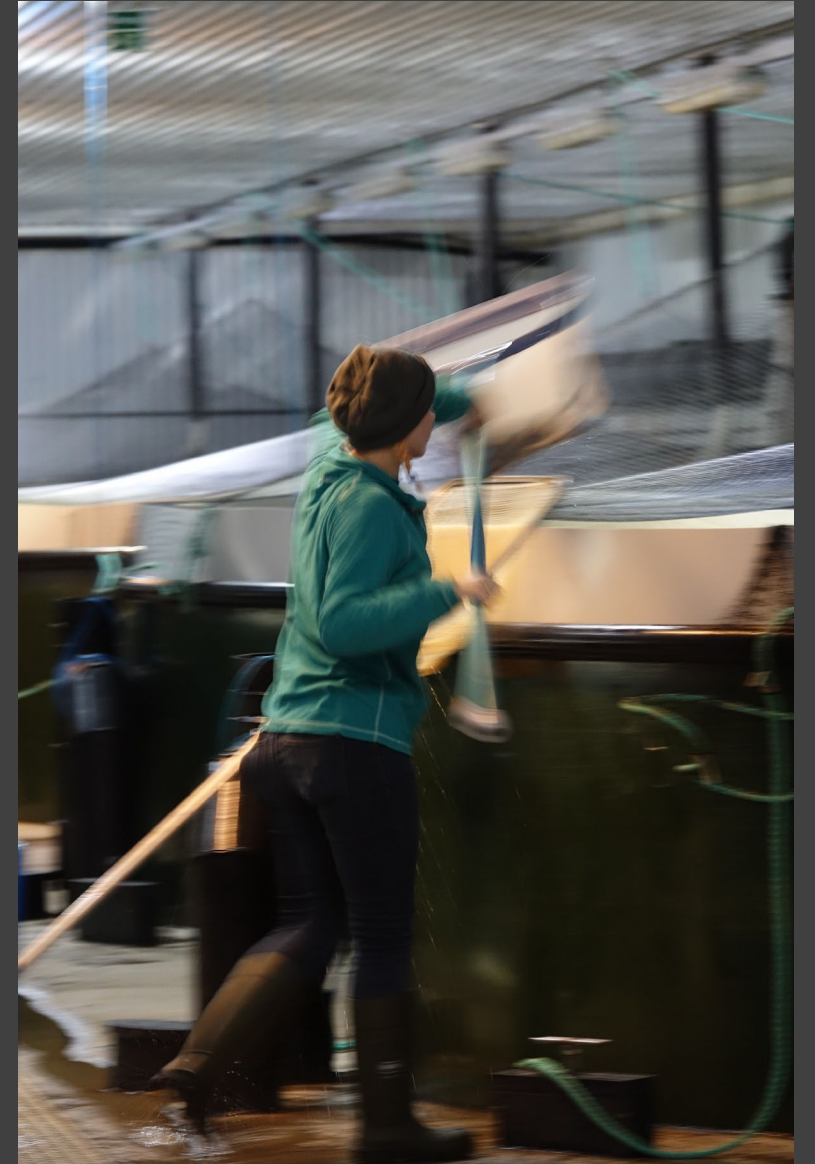
^a Molecular Biosystems Research Group, Department of Chemistry, University of Tromsø, Science Park 3, Sykehusveien 23, FPARK E 112, 9294 Tromsø, Norway

^b Section for Microbiology, Immunology and Parasitology, Department of Food Safety and Infection Biology, Norwegian School of Veterinary Science, PO Box 8146 Dep, 0033 Oslo, Norway





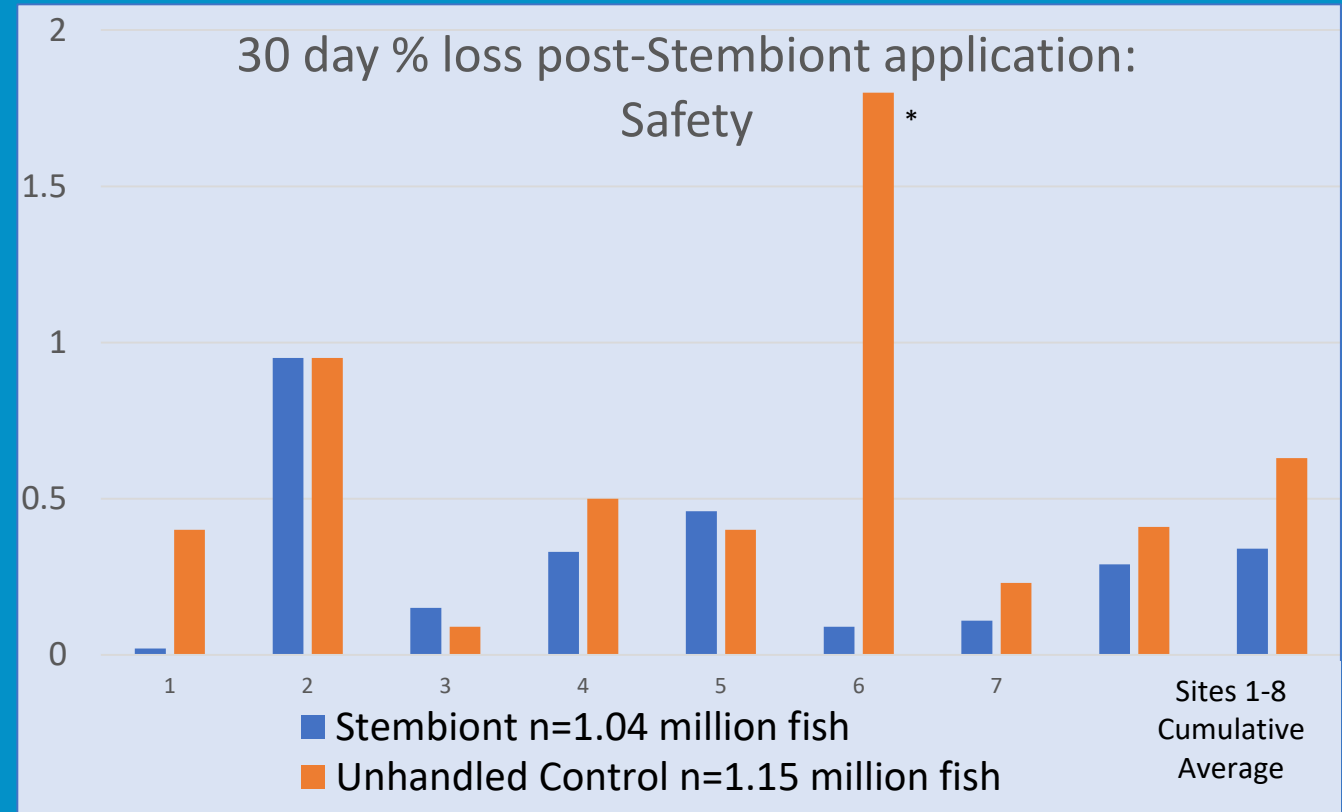
Probiotic bacteria are taken
up in seconds



Extensively tested – safety and proven effect in ‘big’ farm based research

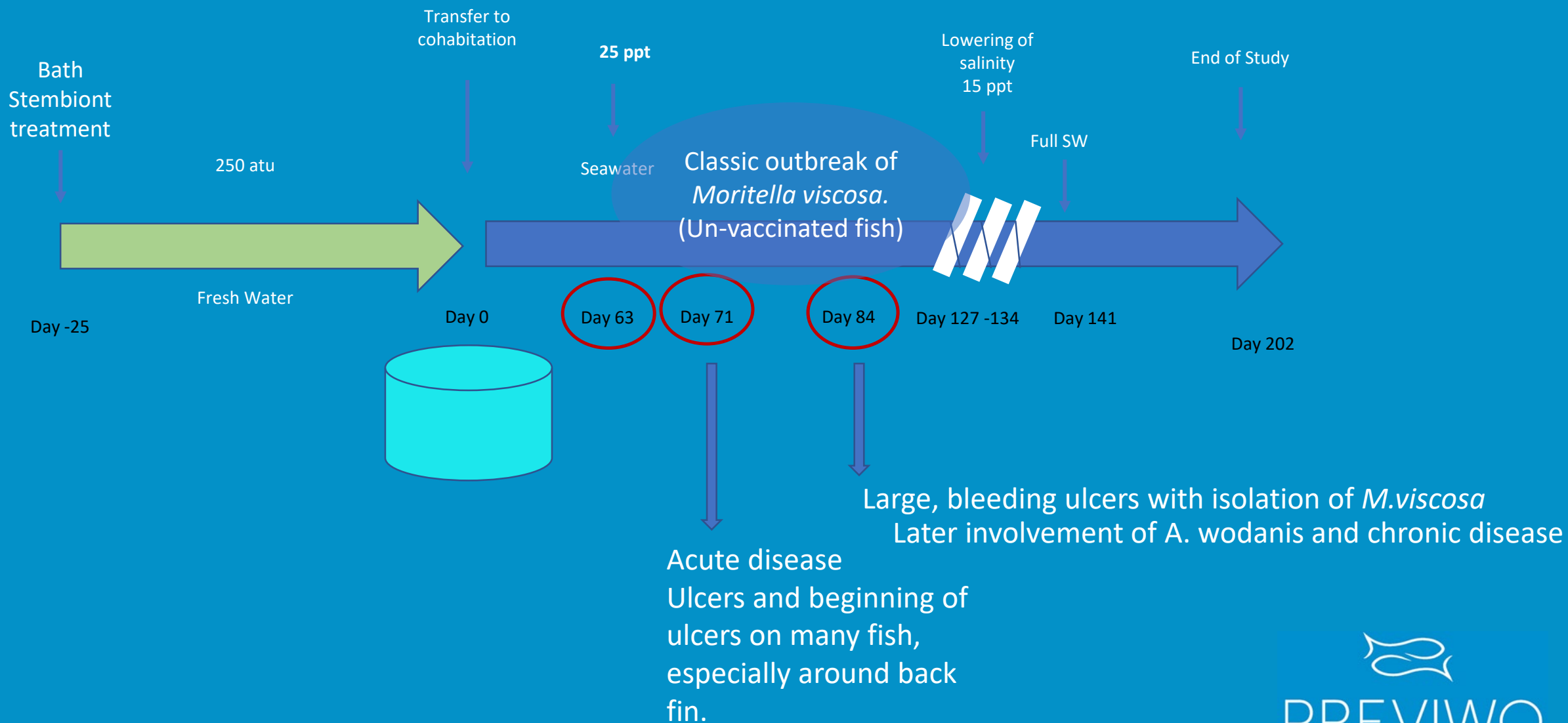
Stembiont studies:

- Initial Safety studies: Injection of bacteria, 10x safety, dip and bath administration at dose
- Studies of uptake - Stembiont
 - Application Exposure Time
 - Appropriate Concentration
 - Proof of concept – land based post smolt production demonstrated growth enhancement
 - Typical challenge with SW-pathogens
 - Weight gain
 - Less ulceration due to classical and atypical ulcerative disease
- Field trials with various in cycle application times prior to SW exposure
- Evidence of an enhanced epidermis and mucus production
- Evidence of potential to reduce viral pathogen impact, seen for comparative mortality to PRV in FW

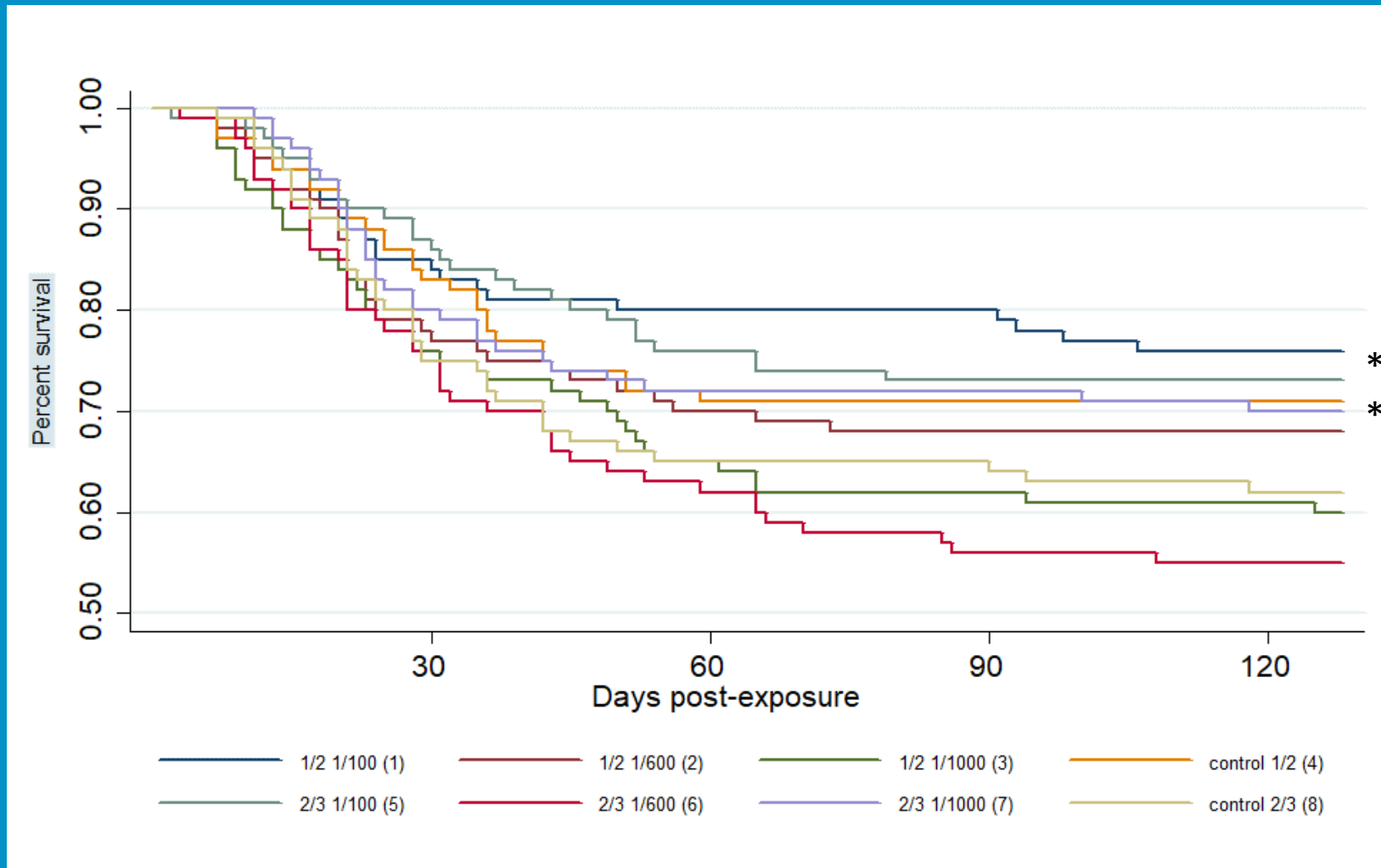


* Cause, PGD

Natural exposure to ulcerative disease



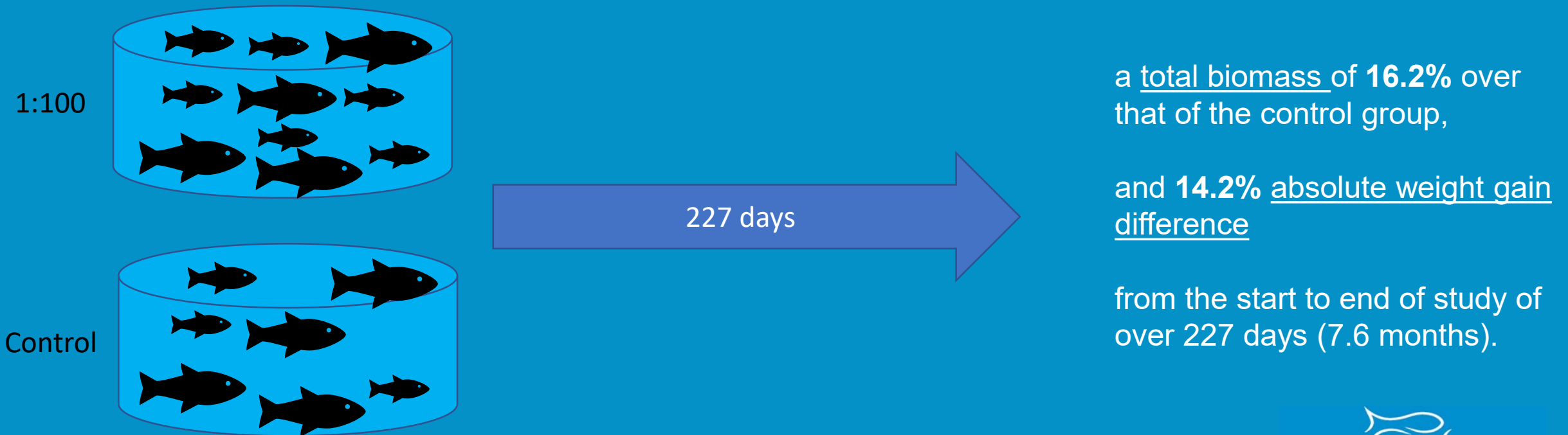
Survival Curves Over Whole Study



One Probiotic bath application reduced mortality significantly

Overall effectiveness on growth

Incremental weight increase over the whole study period was analyzed against the start weight.



What we know and further work

- Significant physiological effects on growth, feed conversion, survival and presence of wounds in commercial production with a one time application
- Does not appear to involve immunological or inflammatory functions
- Demonstrate persistence and tissue distribution
- Measure the observed effect on mucus and goblet cells of the epidermis and sea lice attachment
- Proof of the biological effect of a single treatment through to harvest
- Researching and developing other microbiological enhancement products for the entire life cycle.
- Microbiological predictors of health or disease

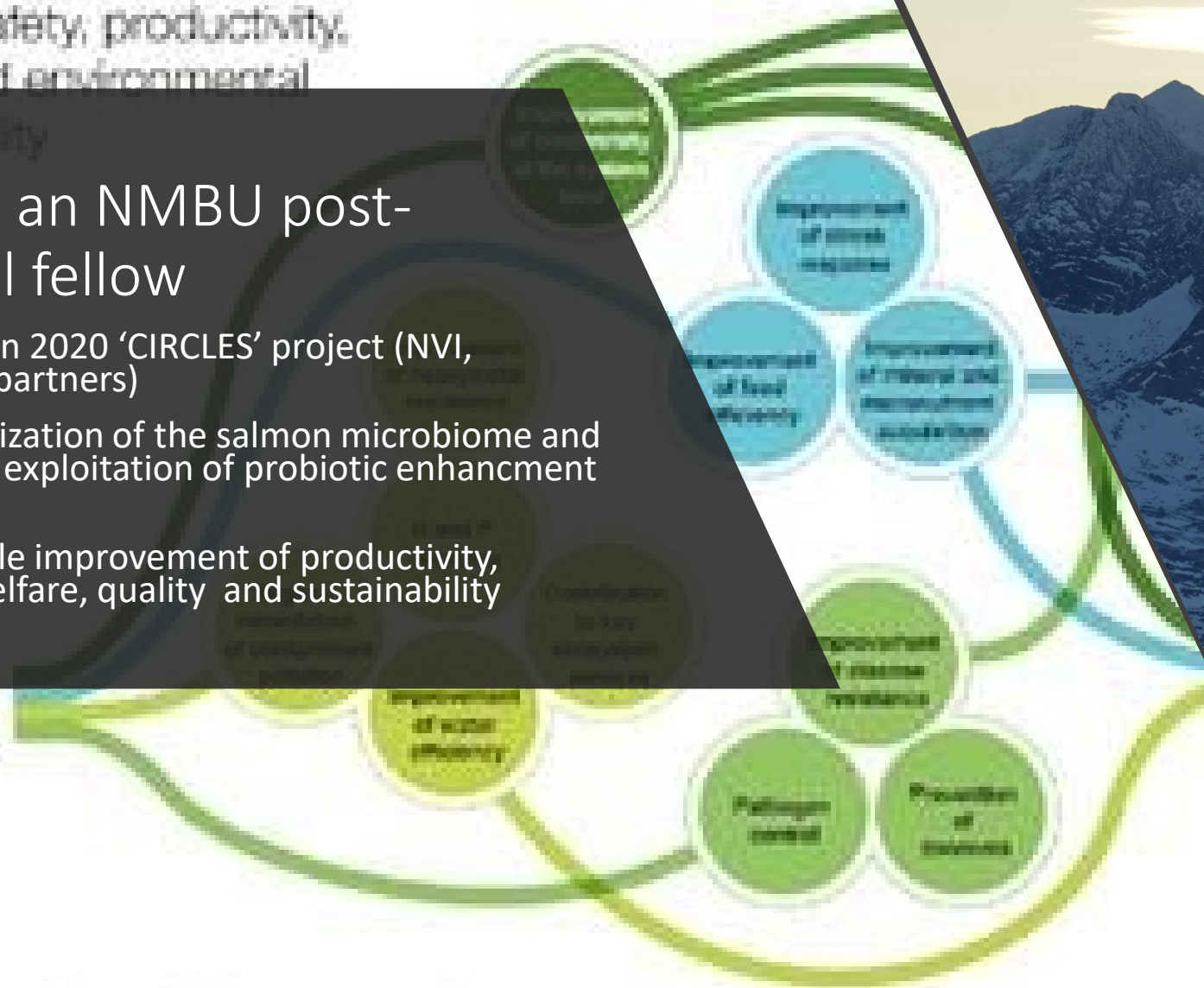
Impact of food system microbiomes

on food safety, productivity, quality and environmental sustainability

Seeking an NMBU post-doctoral fellow

- EU Horizon 2020 'CIRCLES' project (NVI, Nordlaks partners)
- Characterization of the salmon microbiome and impact of exploitation of probiotic enhancement products
- Sustainable improvement of productivity, animal welfare, quality and sustainability

Microbiome influences on food systems



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Thank you!