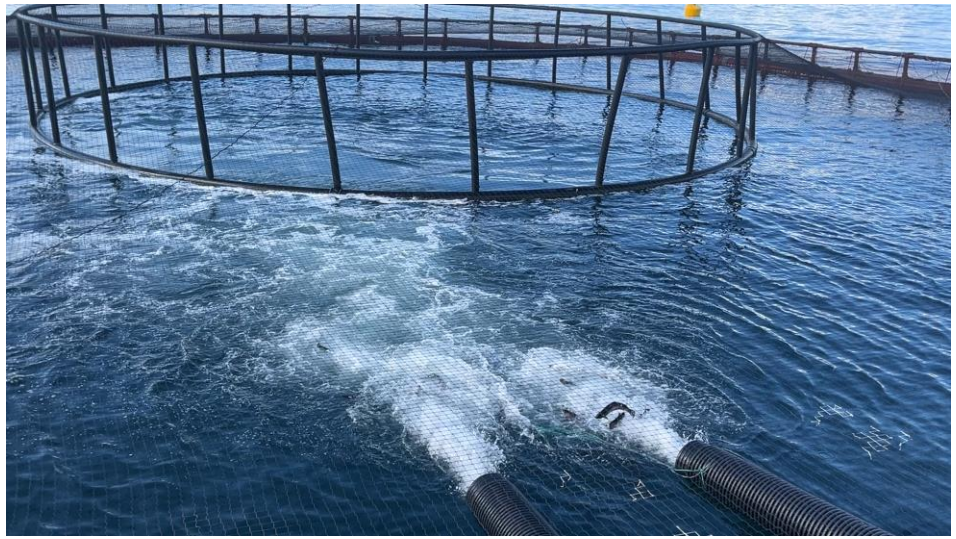
Journey to the Black Sea – Decoding Adaptation Secrets of Rainbow Trout

Ole Christensen

Transfer challenges - from dams to the Black Sea

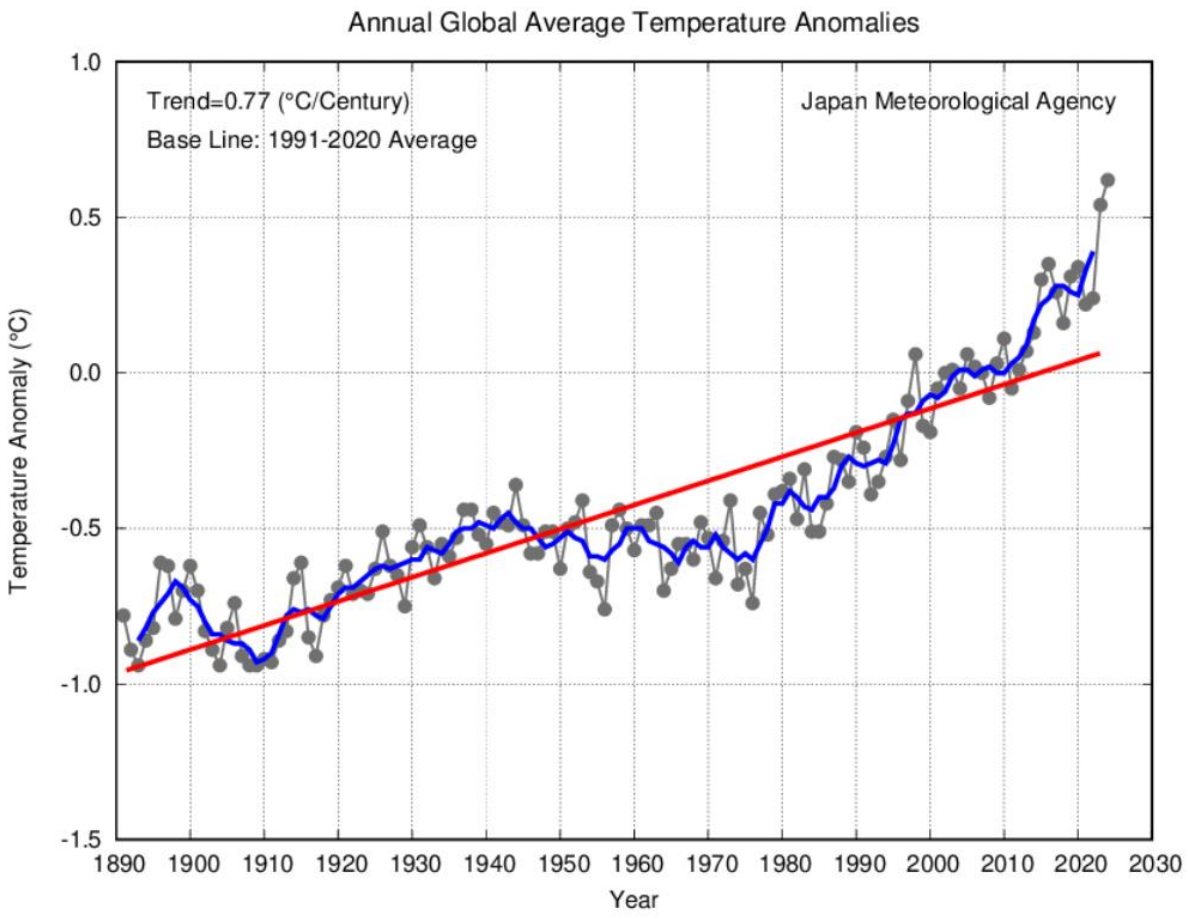
Transfer challenges, from dams to the Black Sea

The challenges during transfer

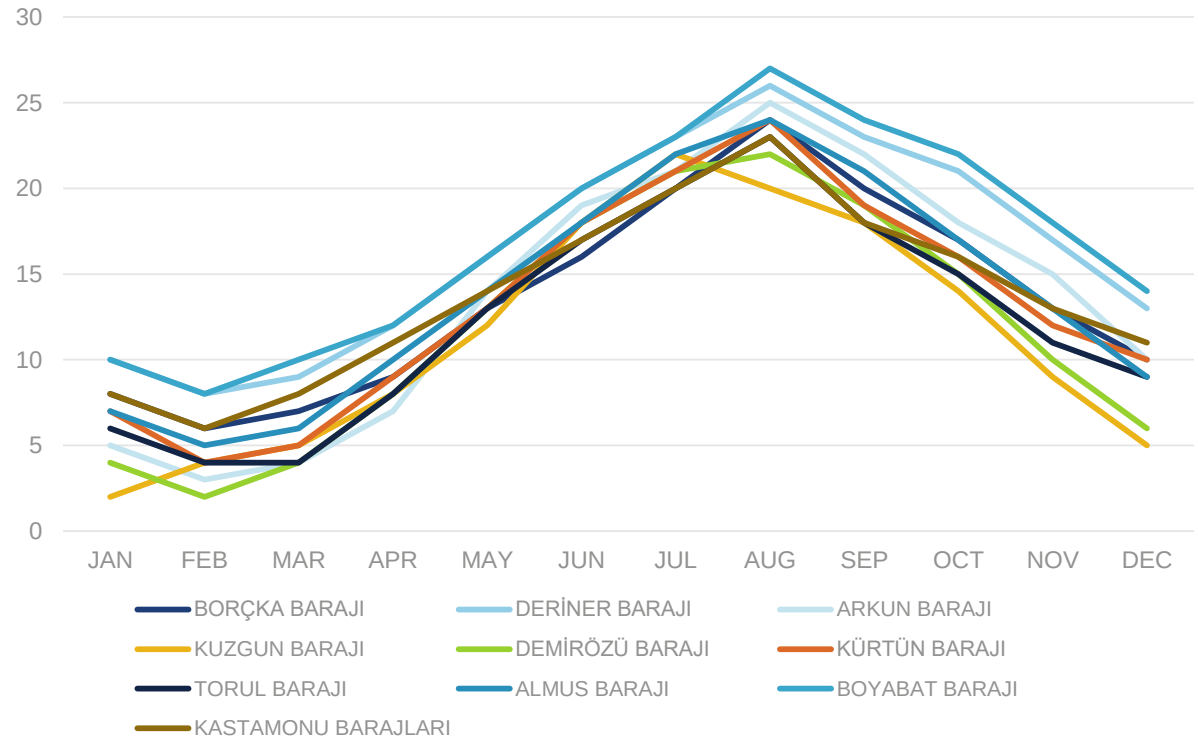


- 7 days of fasting
- Tough handling
- Acute crowding (540 – 600 kg per tank, volume 3.5 m³, or 154 – 171 kg per m³)
- Abrupt changes in water salinity and temperature
- All this leading to a stress situation
- First meals in the black sea will quite often be a medicated feed

Global average Surface Temperature (1891 – 2024)



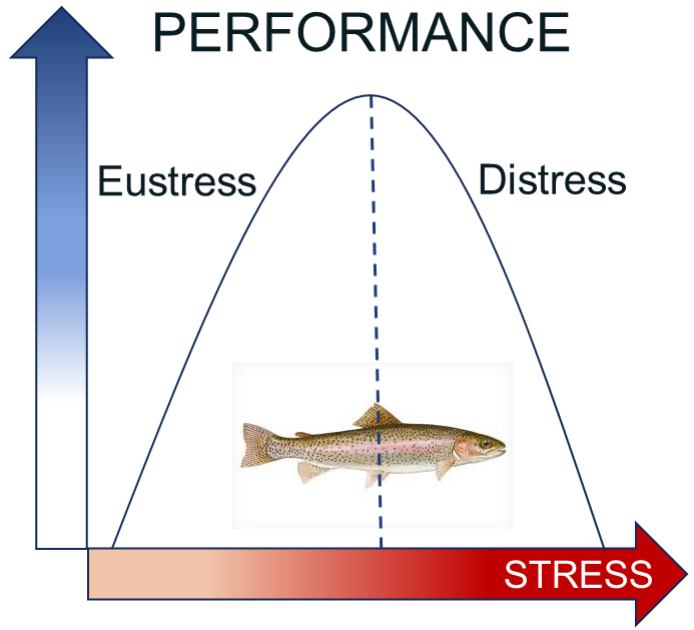
Seasonal fluctuations (Türkiye)

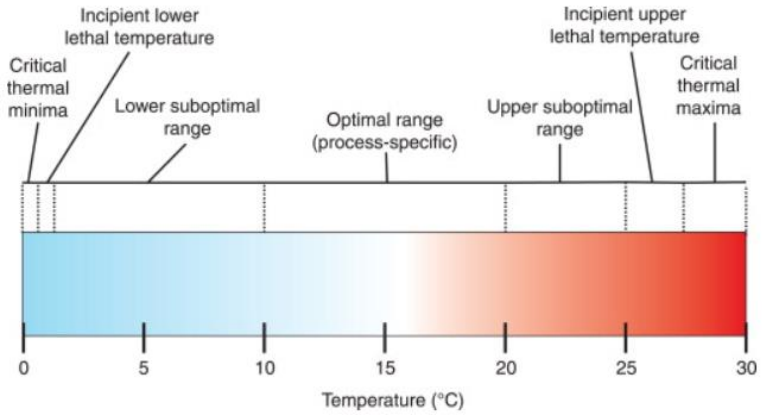


This is a major threat for cultured fish

Temperature tolerance

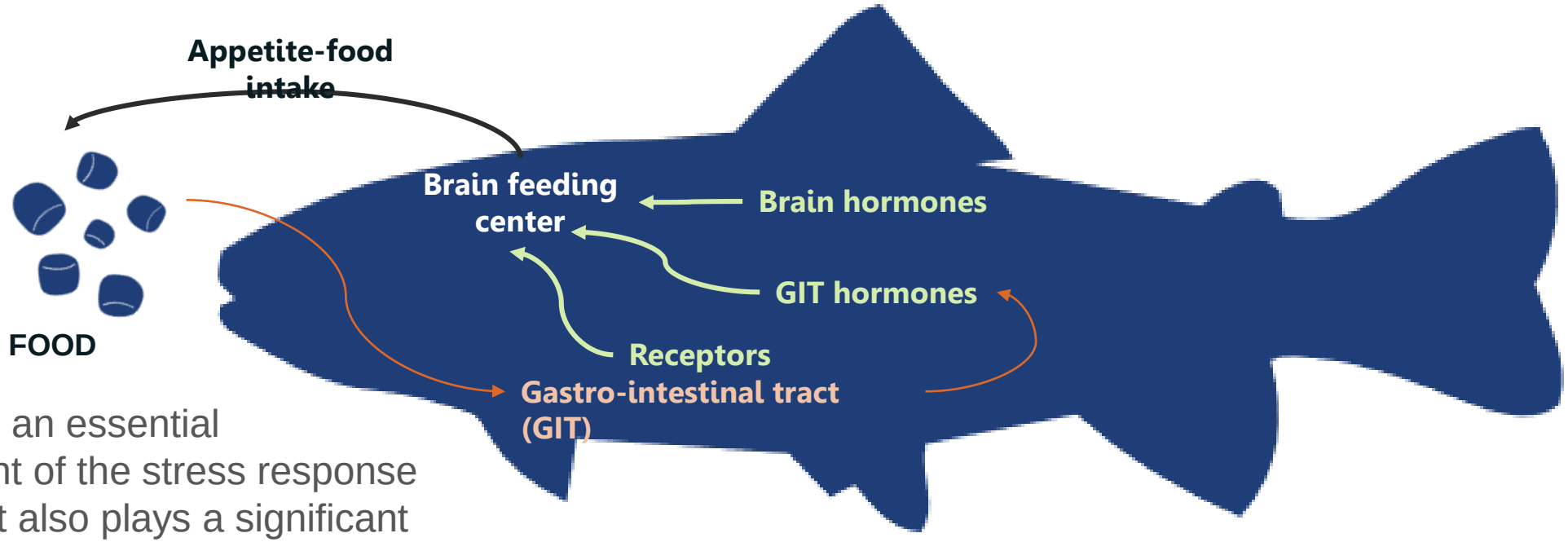
- Fish are ectothermic organisms.
- They display phenotypic plasticity: They can adapt within a range of temperatures.
- Metabolic rate in fish increases 2-3 times to an increase in temperature of 10°C





*Taken from FLOGE

Appetite modulated by stress



Cortisol is an essential component of the stress response in fish, but also plays a significant role in osmoregulation, growth and reproduction.

Several hormones control fish appetite

CORTISOL

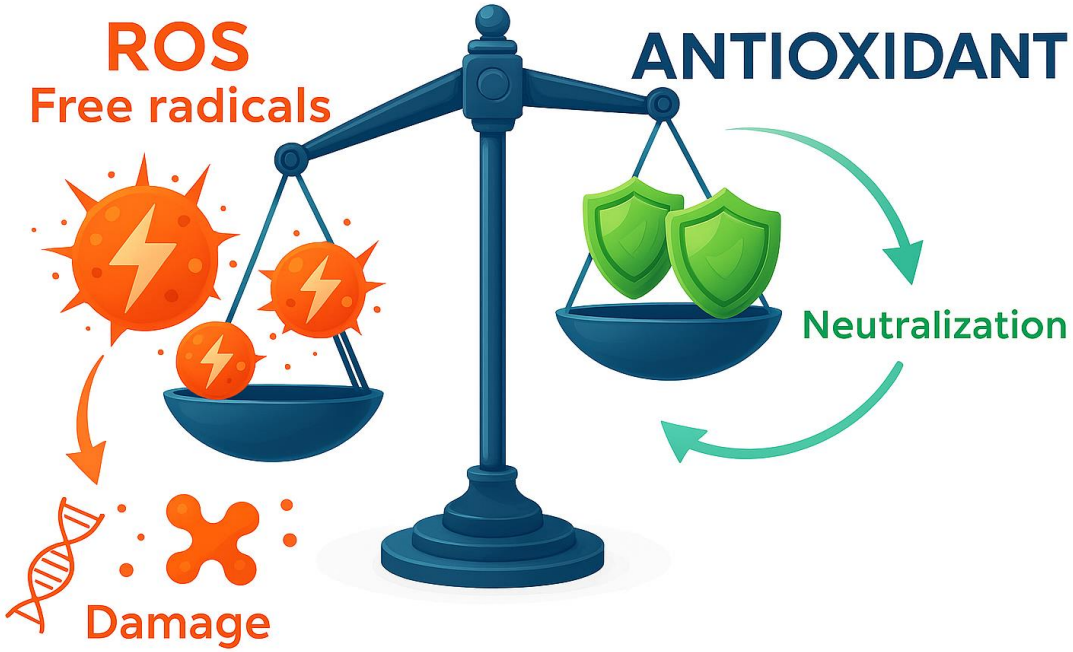
Orexigenic hormones	Anorexic hormones
⬇	⬇
Stimulate appetite	Inhibit appetite

*Taken from FLOGE

Energetic Metabolism

- Thermal stress, induces reallocation of energy that is required for growth.
- Hyperglycemia, is a well documented physiological response in fish when they experience thermal stress, due to the rapid mobilization of energy reserves (glycogen in liver) to cope with increased metabolic demands.
- This can lead to oxidative stress and gut inflammation at chronic high temperatures.

Oxidative stress



- Phagocytes are key in immune response as they activate specific-acquired immunity
- Phagocytes produce reactive oxygen species (ROS), also called free radicals
- ROS are bactericidal agents which eliminate pathogens. An increased production of ROS during stressful conditions generates an imbalance between ROS concentration and antioxidant defense, causing detrimental effects on other essential cell structures
- Under extreme conditions and high oxidant concentration, immune system response is lowered to avoid excessive ROS production

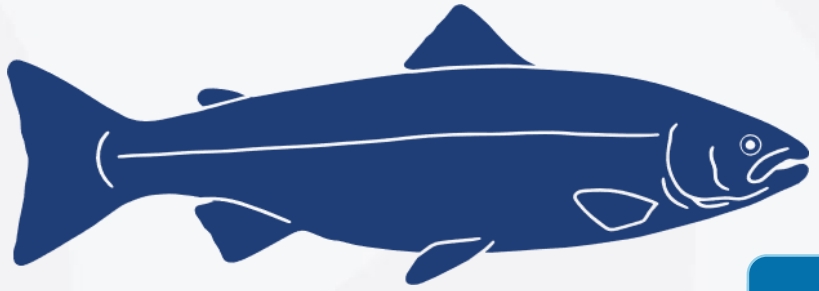
*Taken and modified from FLOGE

Gills' functionality

Gas Exchange

Immune Defence

Osmoregulation



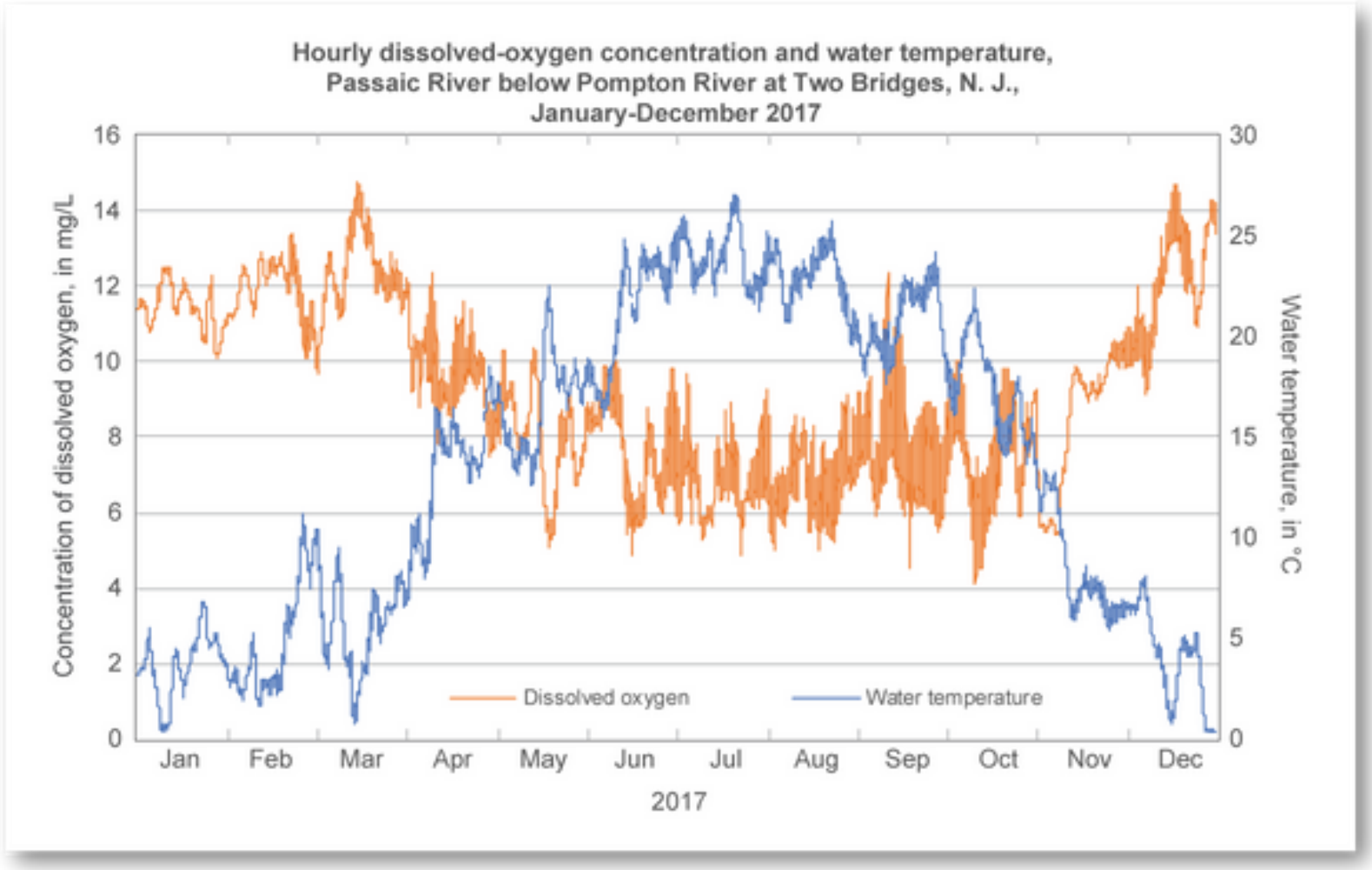
pH regulation

Hormone production

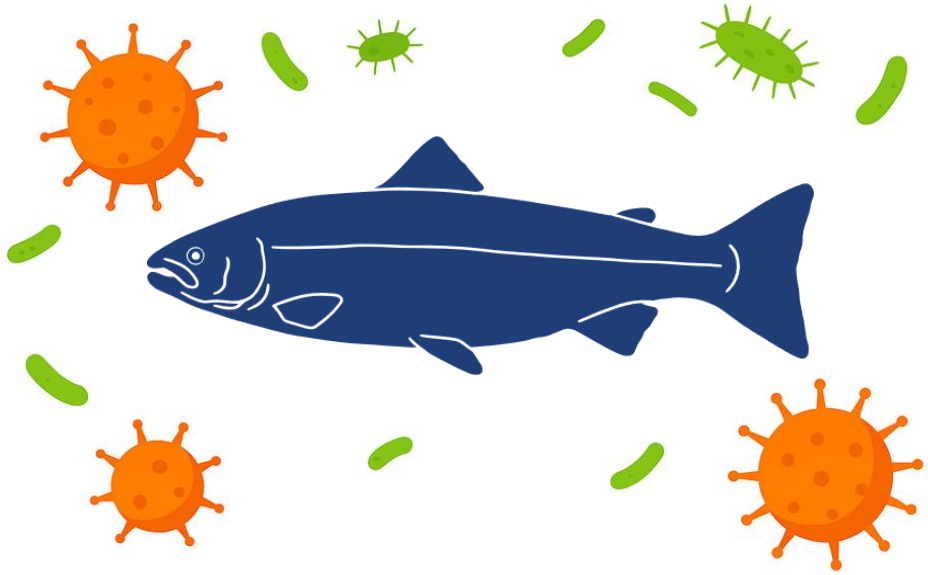
Waste Removal

Water Quality Indicator

Water temperature and DO

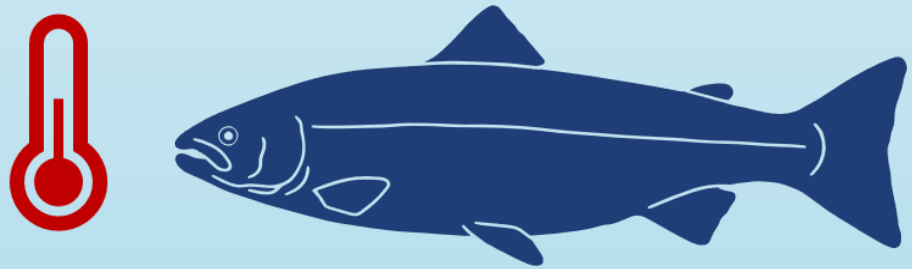


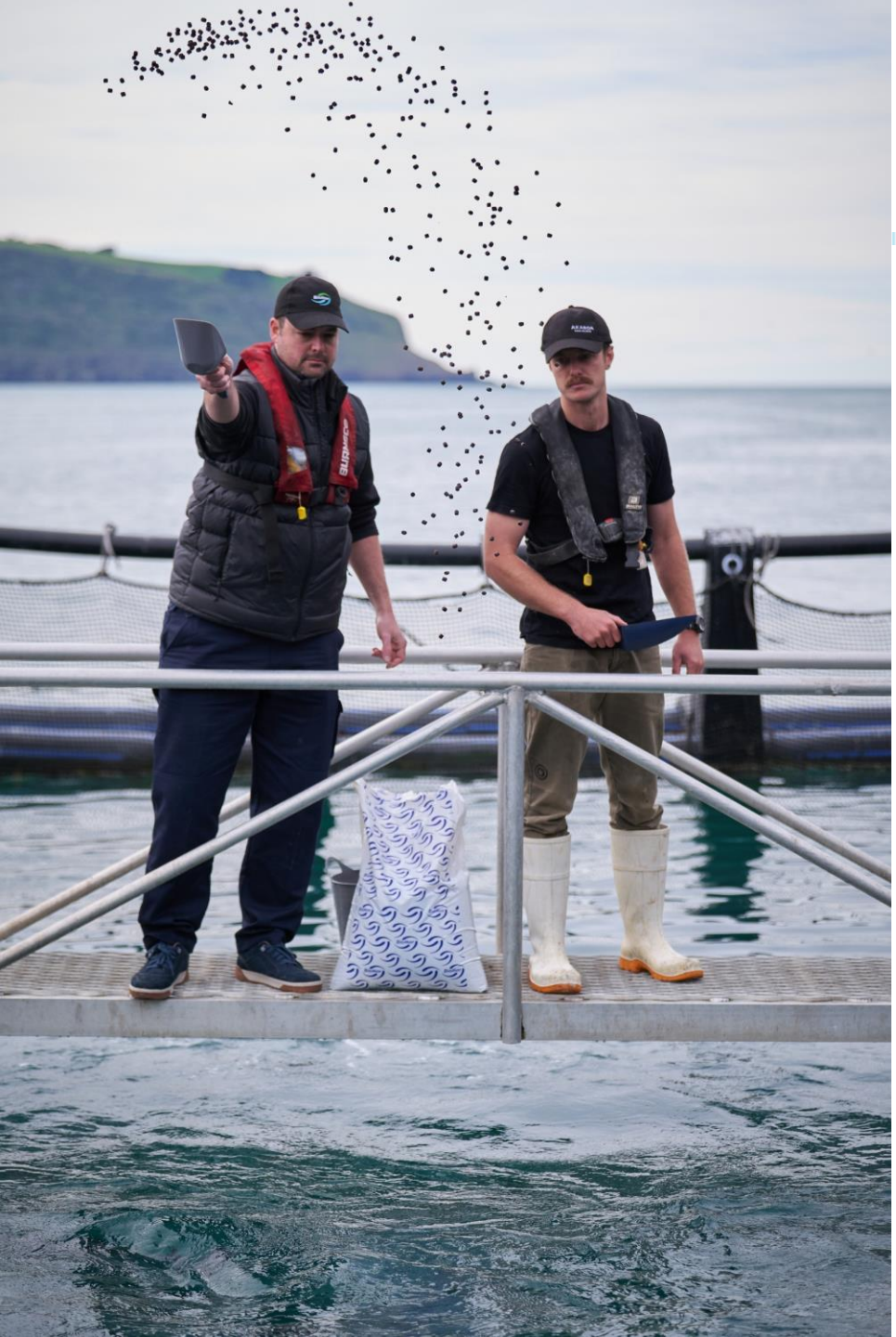
Increased susceptibility to infections



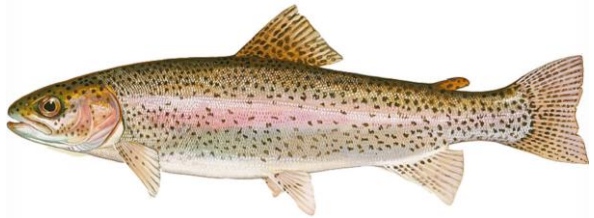
Most common pathogens are thermophilic (*Yersinia ruckeri, Lactococcus garvieae* outbreaks increase above 15°C)

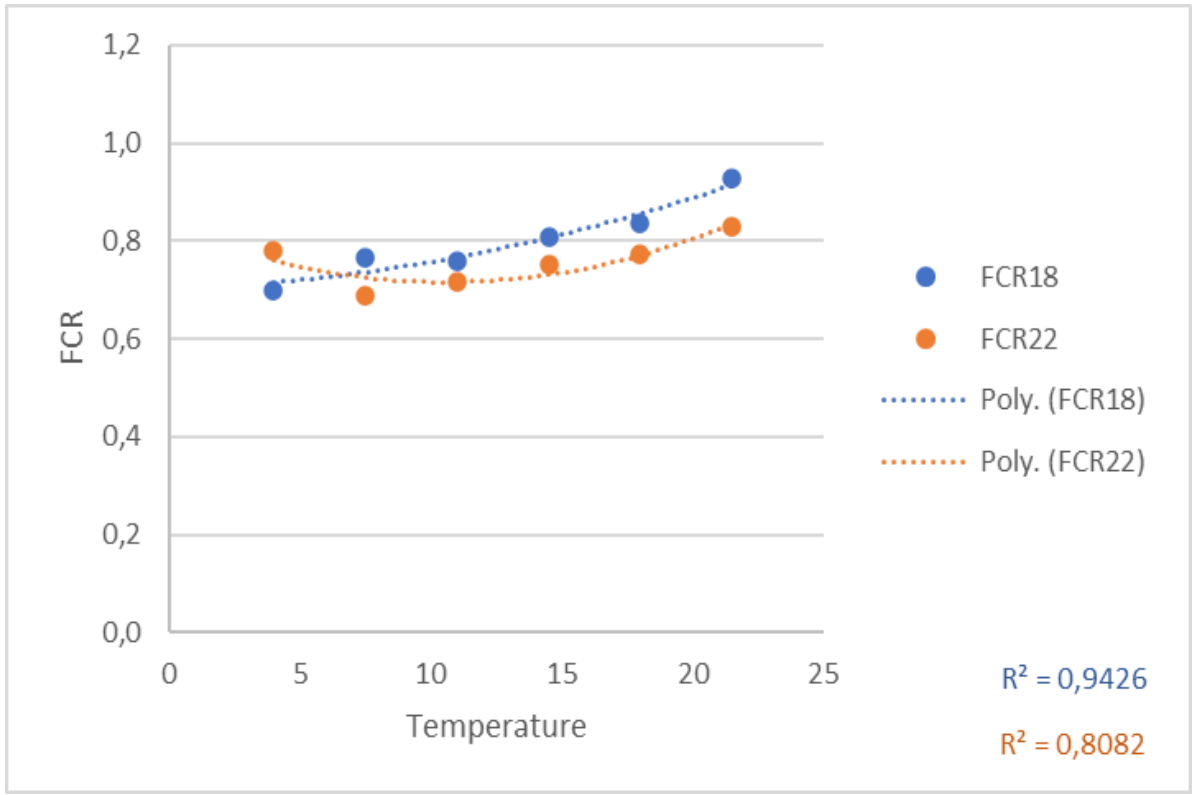
How can we help the fish?





FCR





RD Projects: 718027 & 718032

A better dietary nutrient balance

Evaluate optimal DP:DF:DS ratio in RBT for growth and feed utilization under **optimal and challenging conditions**

OPTIMAL conditions: Less energy coming from starch, and more energy coming from protein and fat **increased SGR and reduced FCR**

CHALLENGING conditions: More energy coming from protein and less energy coming from fat **increased SGR and reduced FCR**

Delivered solid documentation on growth, feed intake, morphology, body composition, nutrient retention, ADC, bioenergetics and nutrient utilization

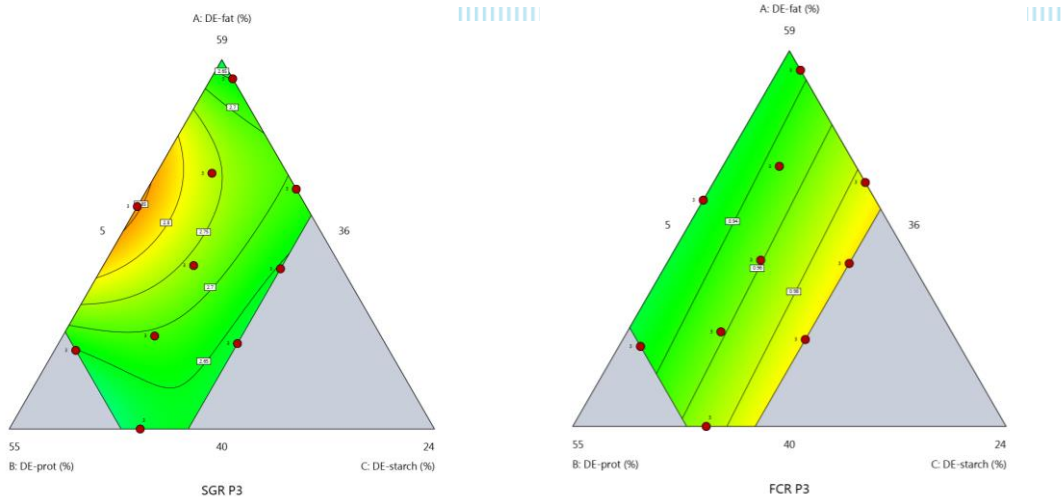


Figure: SGR (2.39-2.93) and FCR (0.82-1.05) for RBT growing from 69-257 g during Optimal conditions

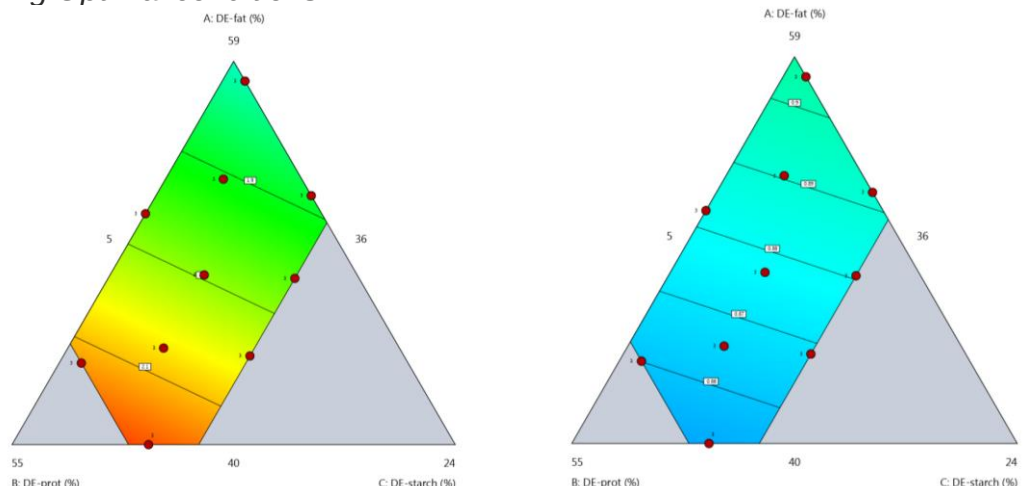


Figure: SGR (1.62-2.21) and FCR (0.80-1.11) for RBT growing from 48-151 g during Chronic crowding stress

Modulation of gut biota – antagonistic effect

Reduction of *Aeromonas* spp. in the intestinal mucosa of Rainbow Trout

- *Aeromonas hydrophilia* has been found as the causative agent of haemorrhagic septicemia disease and furunculosis
- *Aeromonas salmonicida* causes acute and chronic forms of furunculosis
- *Aeromonas caviae* causes bacterial enteritis and furunculosis

TRIAL DETAILS
Location: Plymouth University
Fish size (start): 310 ± 9.1 g
Duration: 4 weeks
Replicates: Quardruplicates
Temperature: 14.7 ± 0.6°C
Diets: Control and with Probiotic
Feeding: 1% of biomass, 2 meals/d

Relative prevalence (%) in the intestinal tract at week 4 (posteria digesta)		
	Control	Probiotic
A. hydrophilia	7.1%	1.0%
A. salmonicida	6.1%	nd.
A. caviae	4.0%	nd.

Study showing:

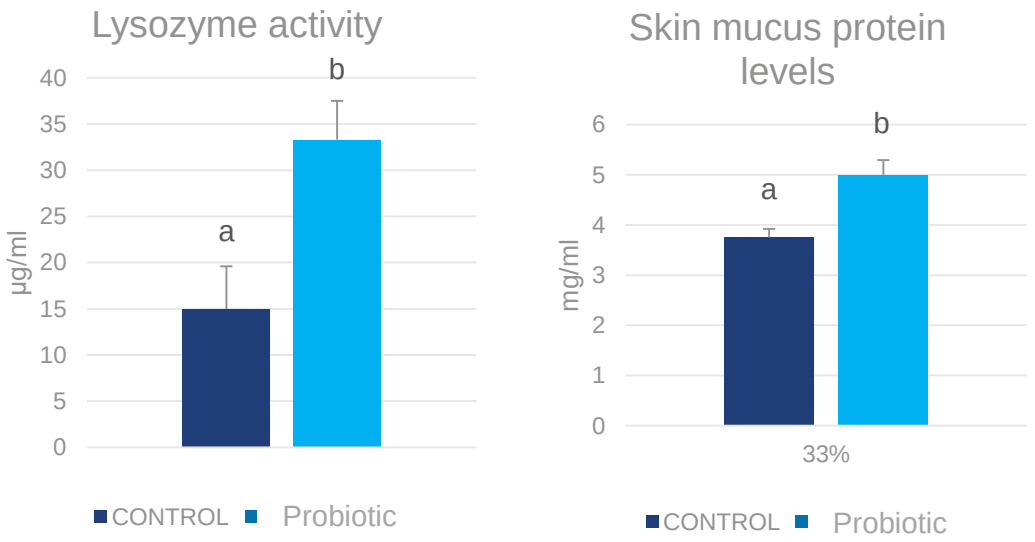
- Significantly increasing microvilli length on feed containing Probiotic bacteria
- Colonization of Probiotic bacteria is seen in the intestine when fed with Probiotic in relation to control

Abid, 2014. Ph.D. dissertation

Probiotic affects positively immune response

Study showing significant improvement in innate immune parameters on fish fed with Probiotic supplemented feed for 8 weeks:

- Significantly increase in serum lysozyme activity (graph to the left)
- Significantly increase in skin mucus protein levels (graph to the right)
- Other immune parameters in this study also improved significantly (respiratory burst, complement activity)



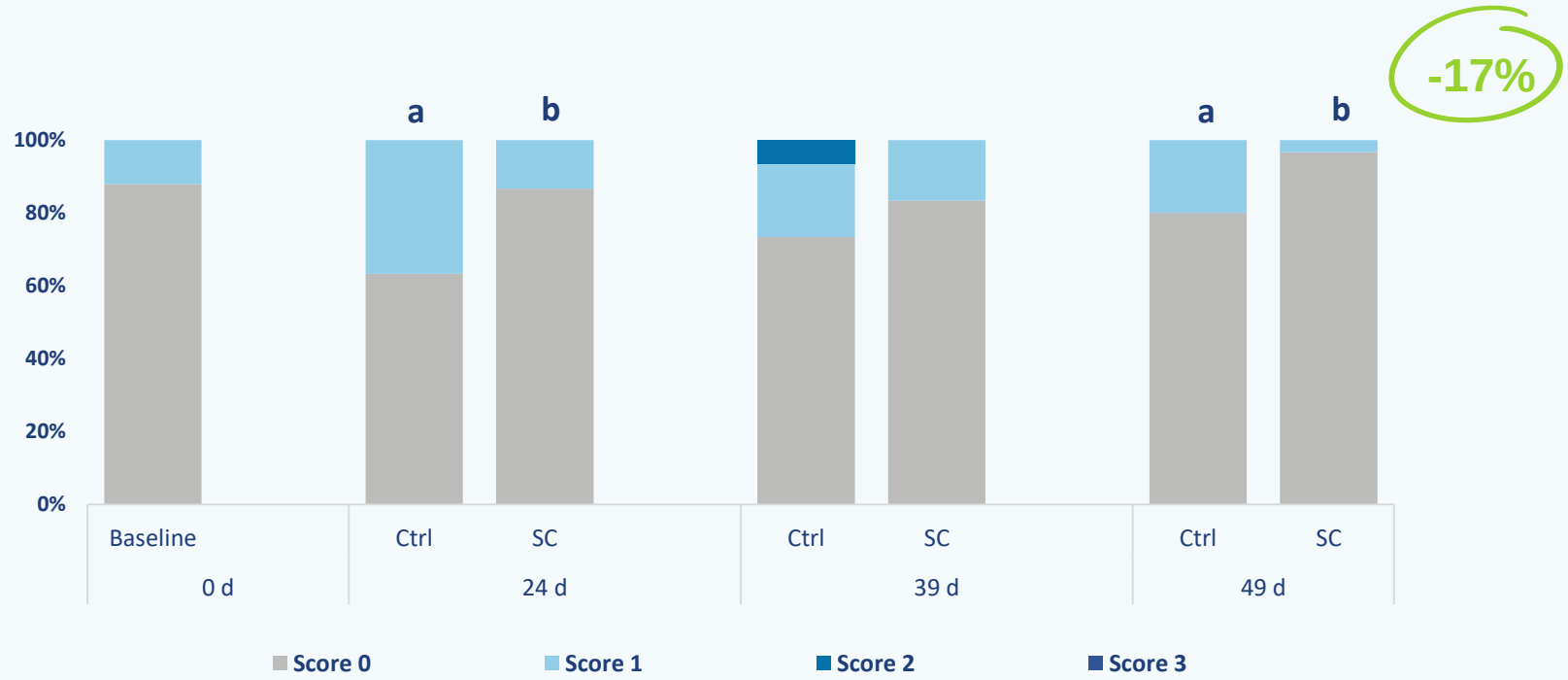
Bars assigned with different superscripts are significantly different ($P < 0.05$); Values are presented as the mean ± SE.

TRIAL DETAILS
Location: Gorgan University of Agricultural Sciences and Natural Resources
Fish size (start): Rainbow trout 15 g
Duration: 8 weeks
Replicates: triplicates
Temperature:14,3 ±1,2 °C
Diets: Control and with Probiotic
Feeding: 3% biomass/day

S.H. Hoseinifar et al. (2015) Fish & Shellfish Immunology 45: 27-32

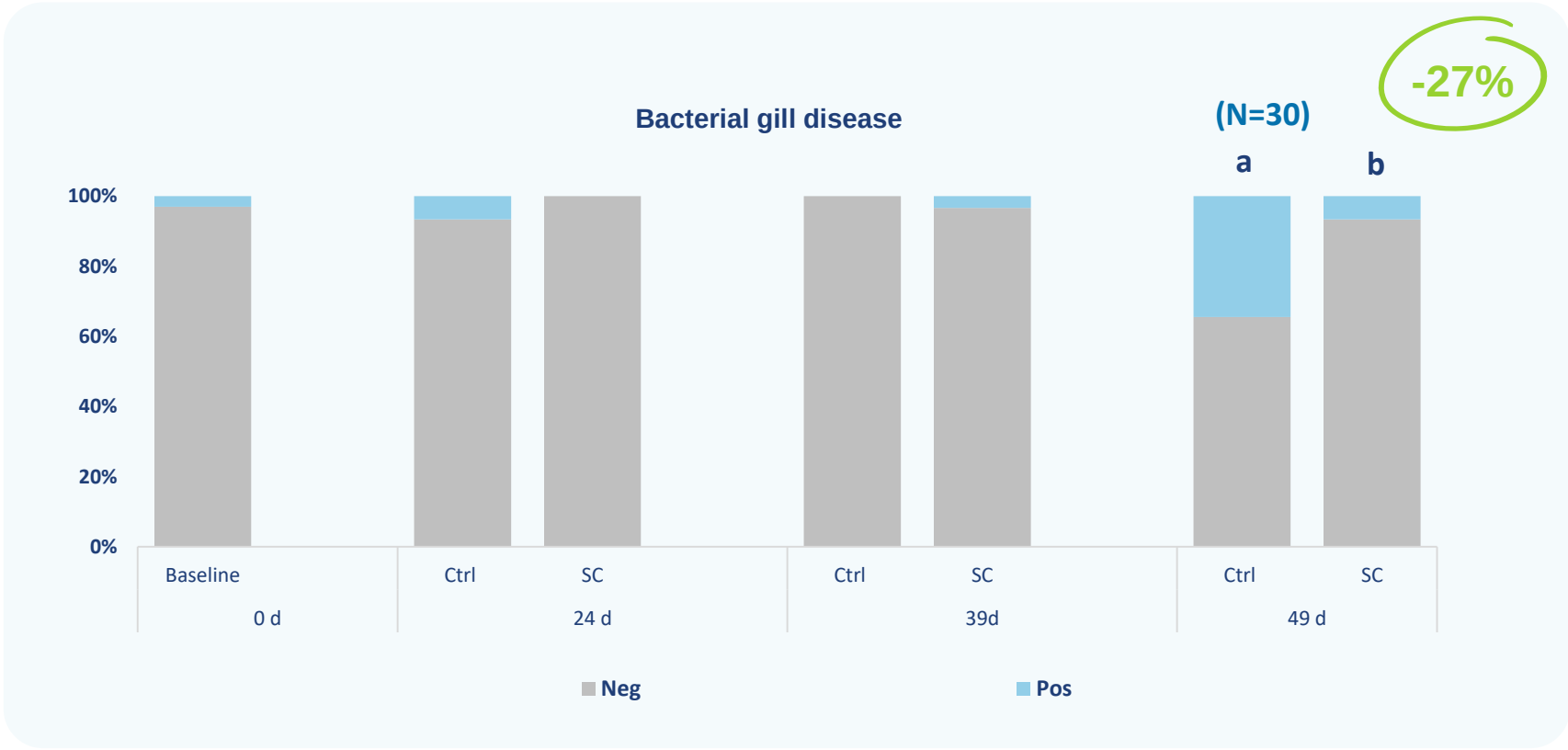
Improved gill health

Improved Macroscopic Gill score

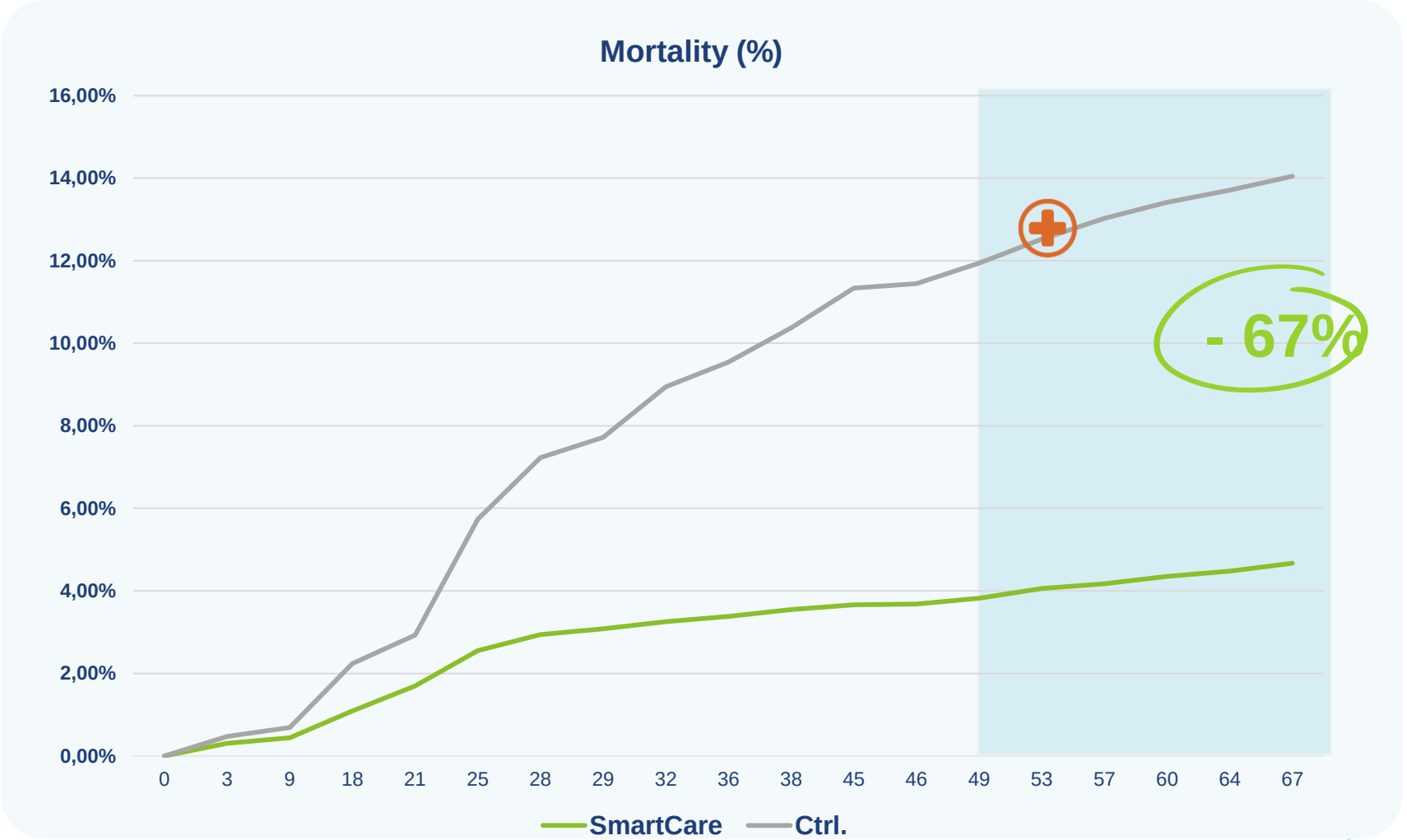


Improved gill health

Resistance to bacterial infections

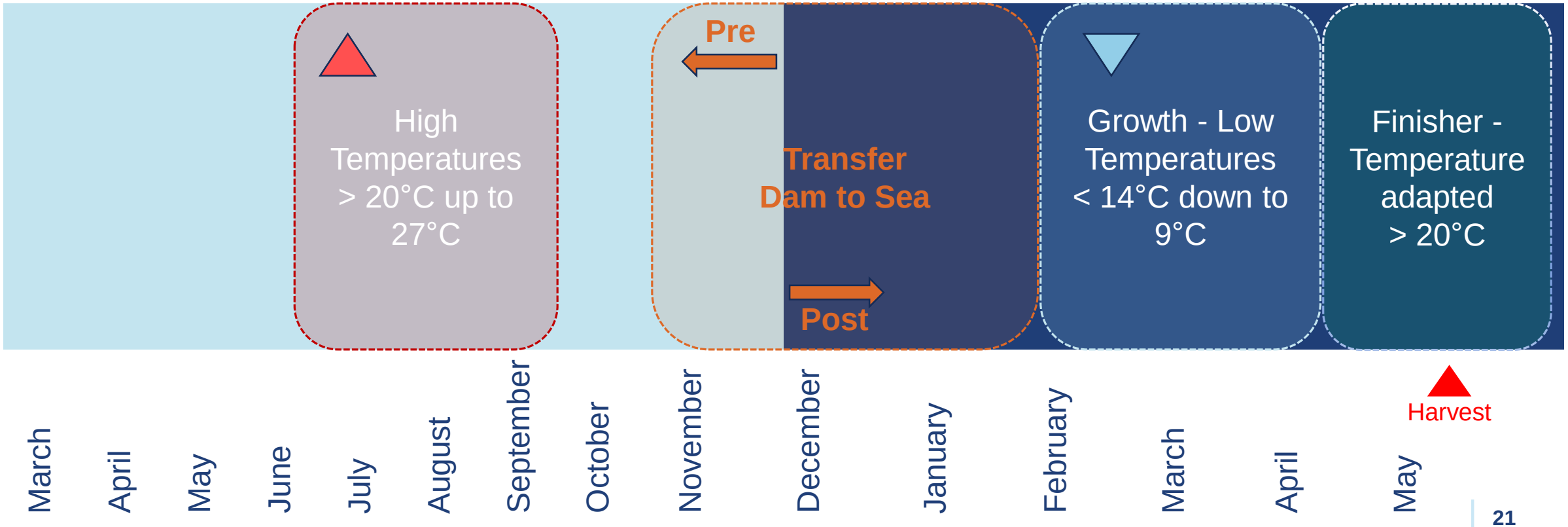


Improved gill health



Product strategy to cover full cycle

Recommended to be used as a “Post-transfer” diet (3 – 4 weeks after medicated feed) and during challenging conditions related to low temperatures.



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