

# Health and performance of Atlantic salmon post-smolts when using novel production protocols

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# Objective:

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The industry is already using practices when producing large fish for stocking, that have not been evaluated scientifically, in terms of effects on fish performance, health and welfare

Objective: To evaluate the effect of different postsmolt production protocols in RAS on fish performance, health and welfare in the seawater growout phase

«Best in RAS =best in the sea?»

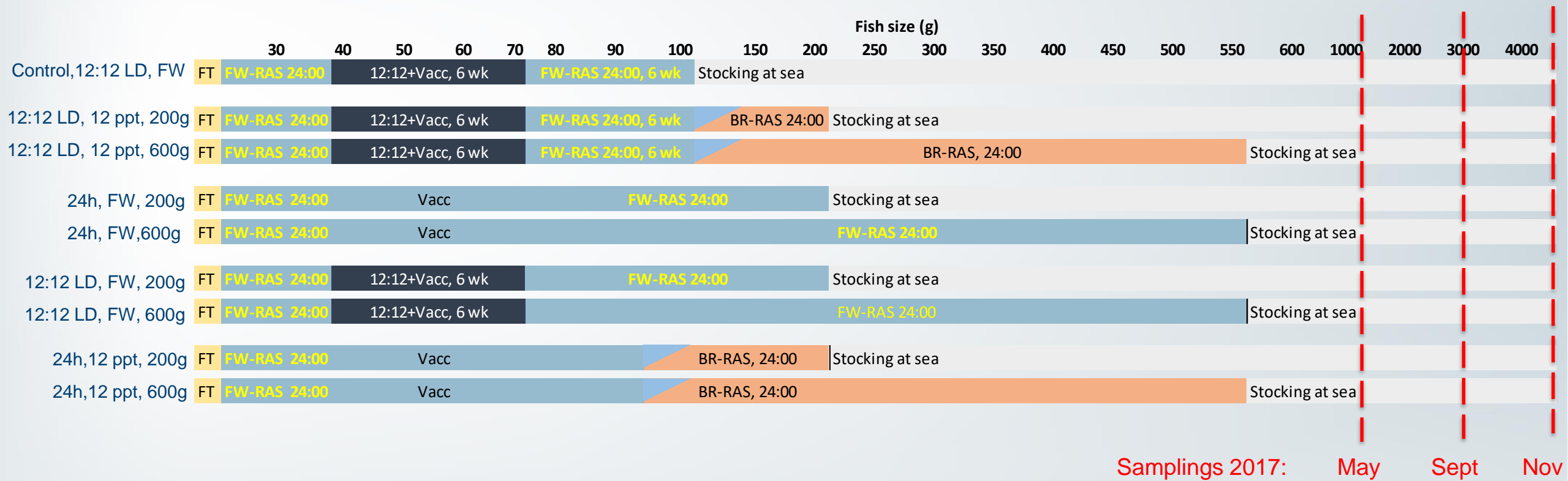
Hypothesis: An extended land-based phase in RAS will improve fish performance in sea cages

# Experimental design :

2x2 factorial design with salinity and light treatments as factors, and transfer to seawater pens at 200 and 600 g

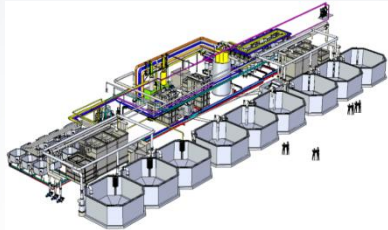
Control group «traditional» 100 g smolt, 12:12 L:D, 6 weeks

Light \ Salinity	FW	12 ppt SW
	FW x 12:12	12 ppt x 12:12
12:12	FW x 12:12	12 ppt x 12:12
24:00	FW x 24:0	12 ppt x 24:0



# Response variables

## RAS Sunndalsøra



- **SGR/TGC**
- **Survival**
- **Maturation**
- **Seawater tolerance**
- Welfare
- Cataract
- Skin health
- Deformities
- Pigmentation
- Vaccine sideeffekts
- Immunocompetence

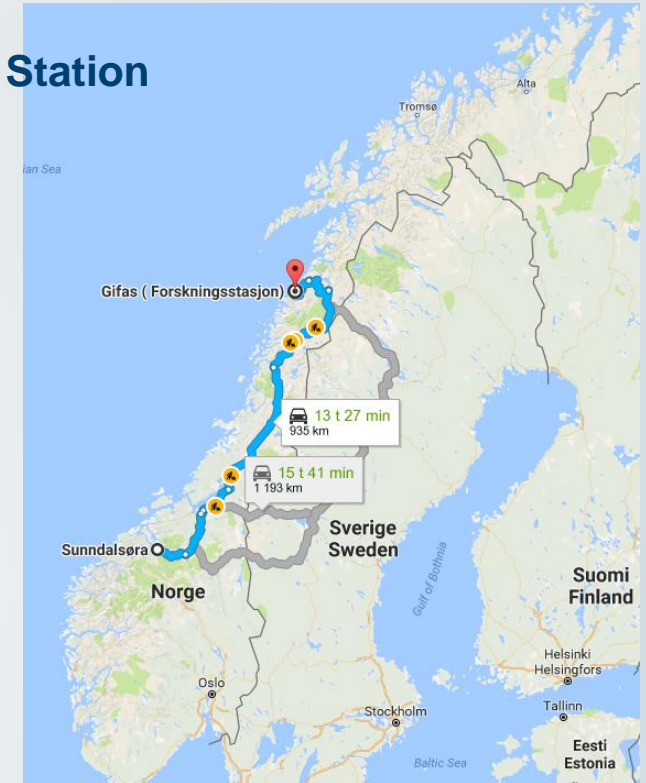
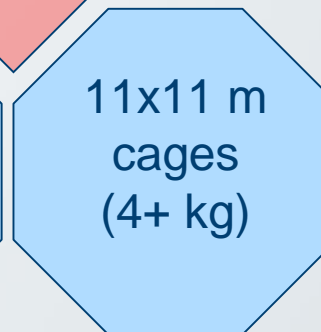
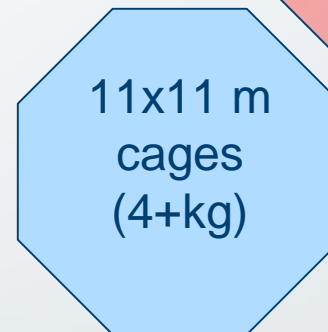
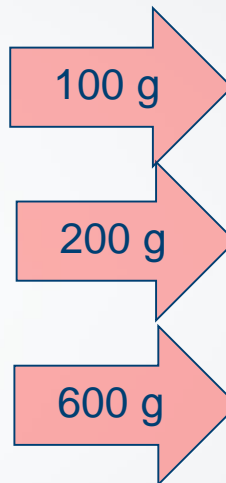


## Gildeskål Research Station (GIFAS)

(5x5x5 m cages)

1<sup>st</sup> period in the sea  
5 weeks after transfer

**Feed intake**  
**Survival**  
**FCR and growth**



- **SGR/TGC**
- **Survival**
- **Maturation**
- Welfare
- Cataract
- deformities
- Pigmentation
- Slaughter quality
- Vaccine sideeffects



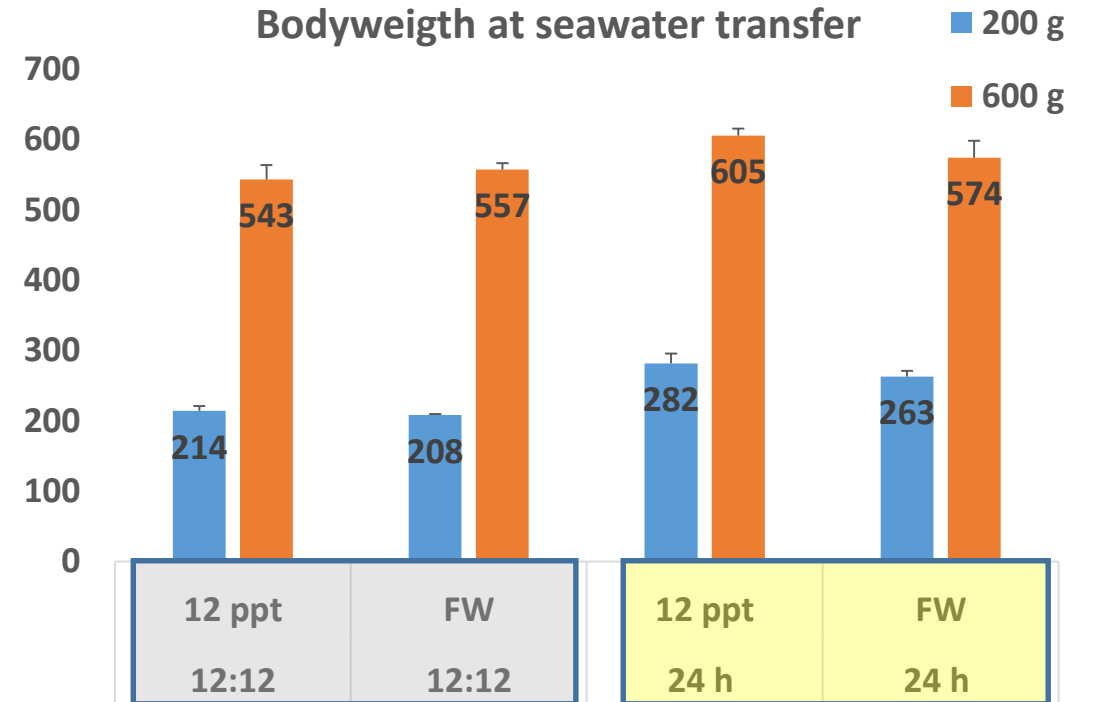
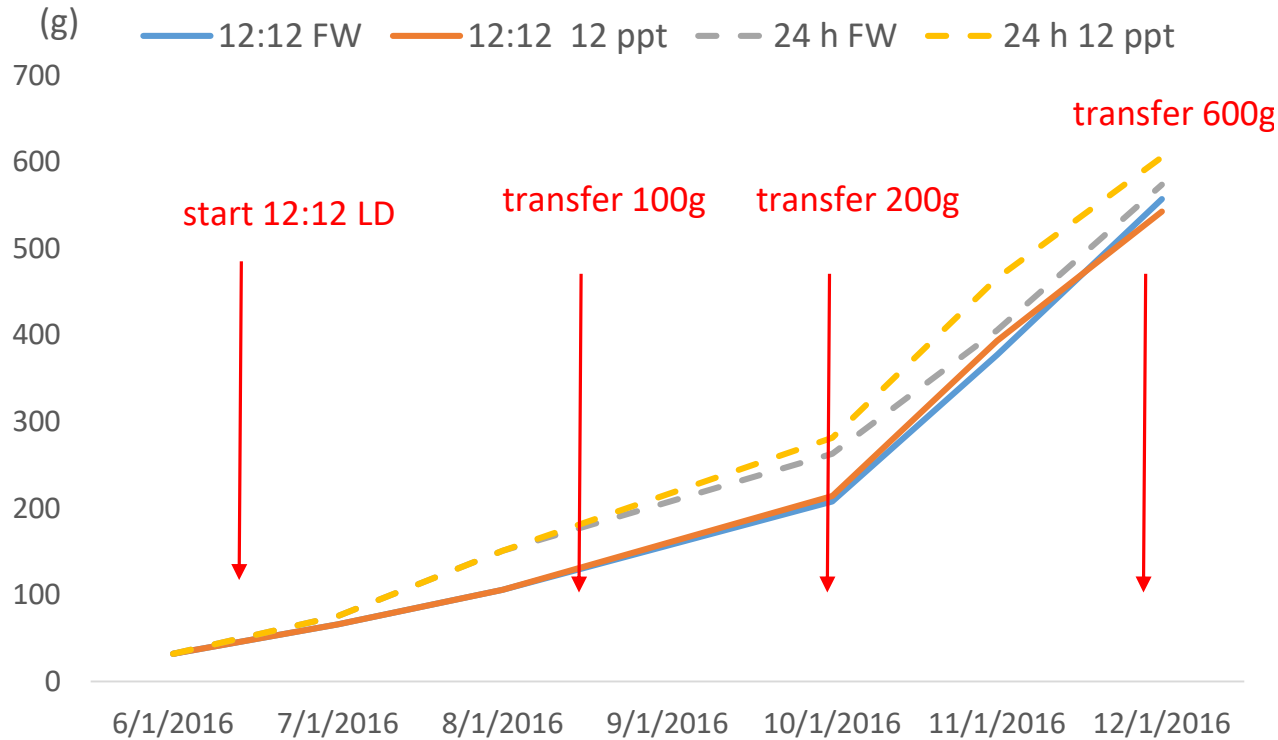
# RAS conditions

- 3.3 m<sup>3</sup> tanks, 300 fish per tank, PIT-tagged
- Temperature: 12-13 °C
- Recirculation: >99%, ~20% exchange/day
- No ozone
- O<sub>2</sub> >85% saturation (tanks controlled independently)
- pH > 7.5,
- CO<sub>2</sub> < 10 mg/L
- TAN < 1.0 mg/L
- Nitrite < 0.2 mg/L
- Water velocity: ~1 BL/sec
- Max. density 50 kg/m<sup>3</sup>
- Commercial diets

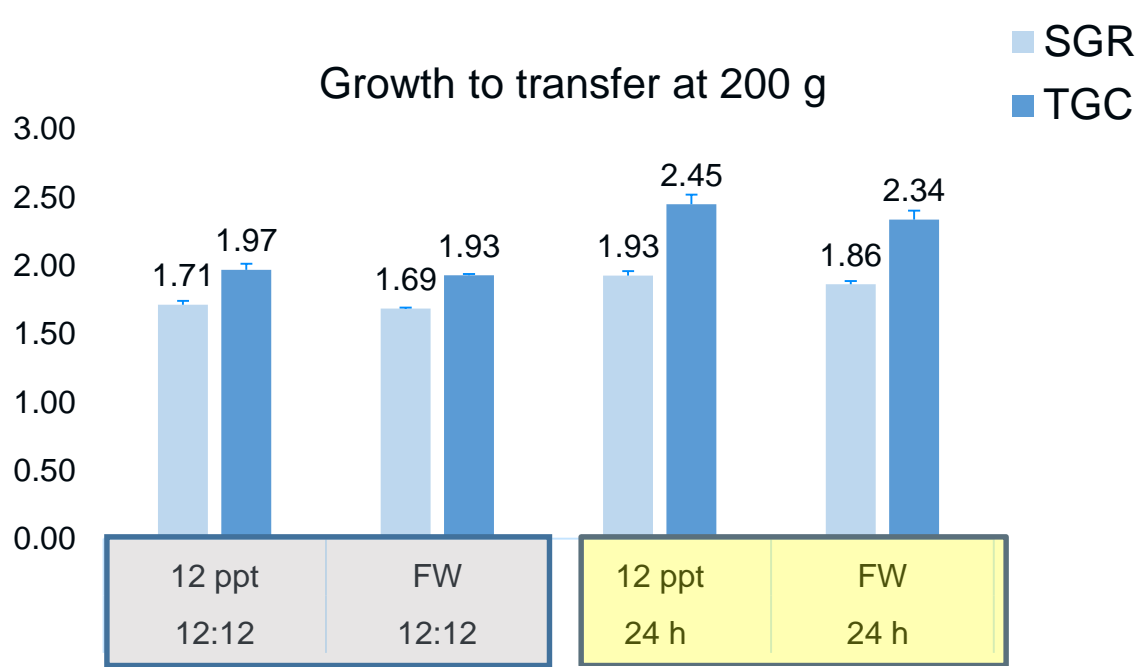


# Performance in RAS:

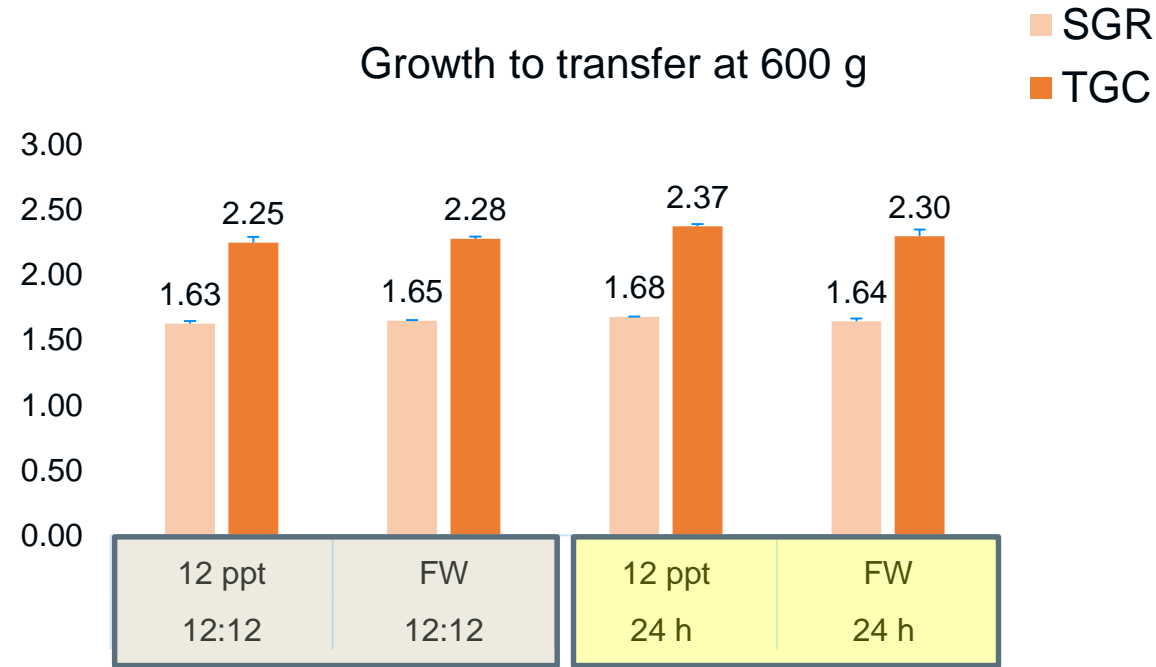
- 24:0 improved growth in RAS
- 12 ppt improved growth in fish kept on 24:0 LD
- Low mortality (>0.5 %)



# Specific growth rate (SGR) and thermal growth coefficient (TGC) in RAS:

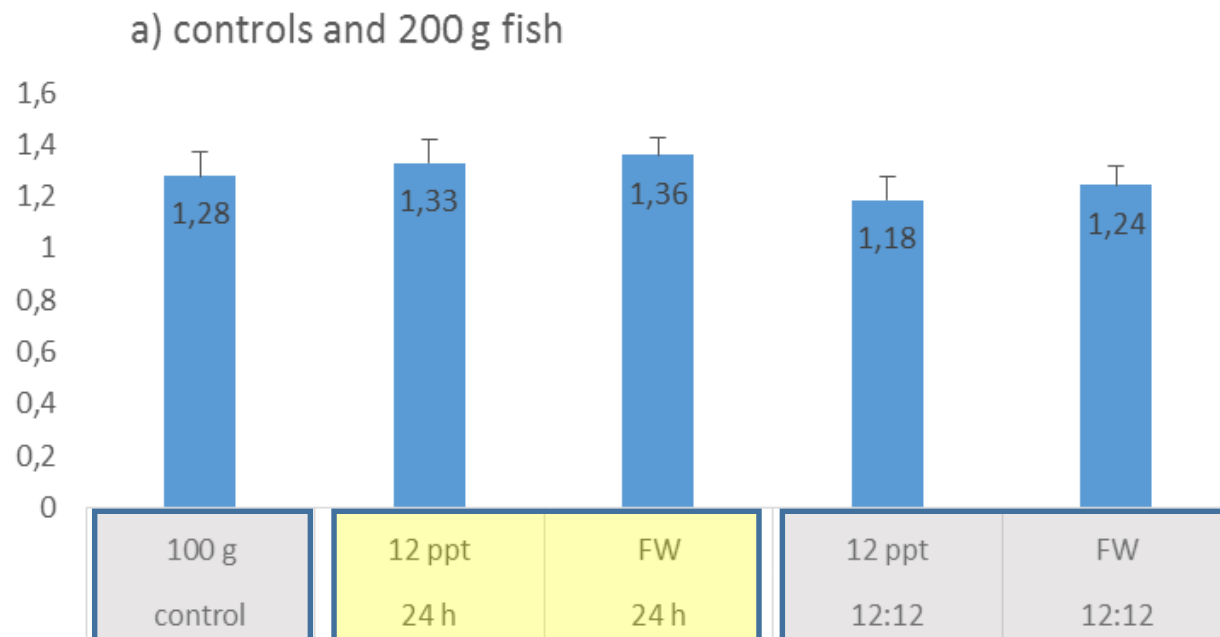


200g: 24:0 >12:12 , 12 ppt > FW

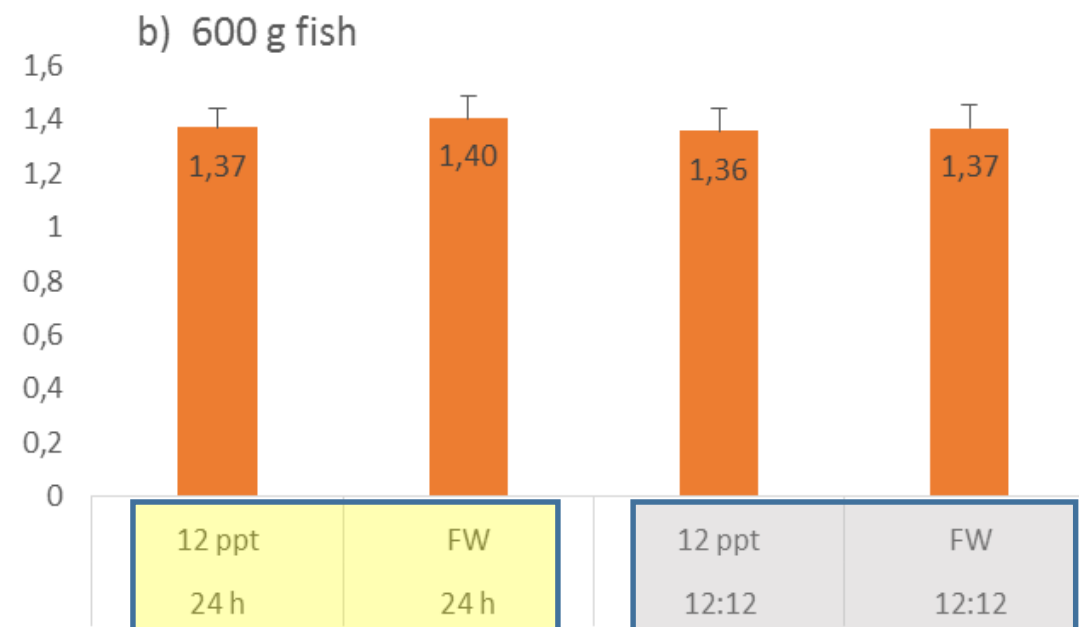


600g: 24:0 >12:12 salinity, NS

# Condition factor (CF) in RAS



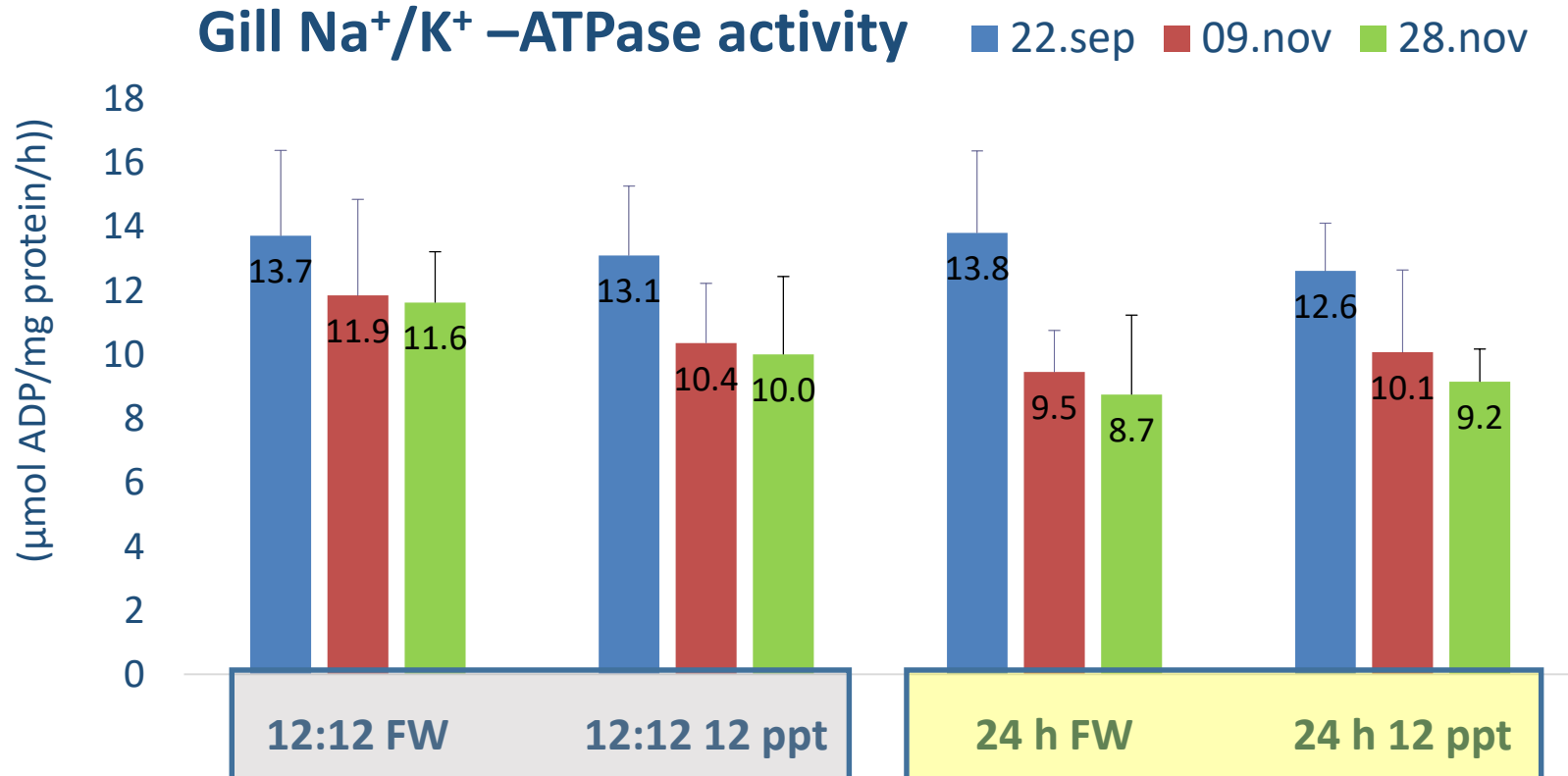
200 g: 24:0 > 12:12 , FW > 12 ppt



600 g: No effect of salinity or light treatment



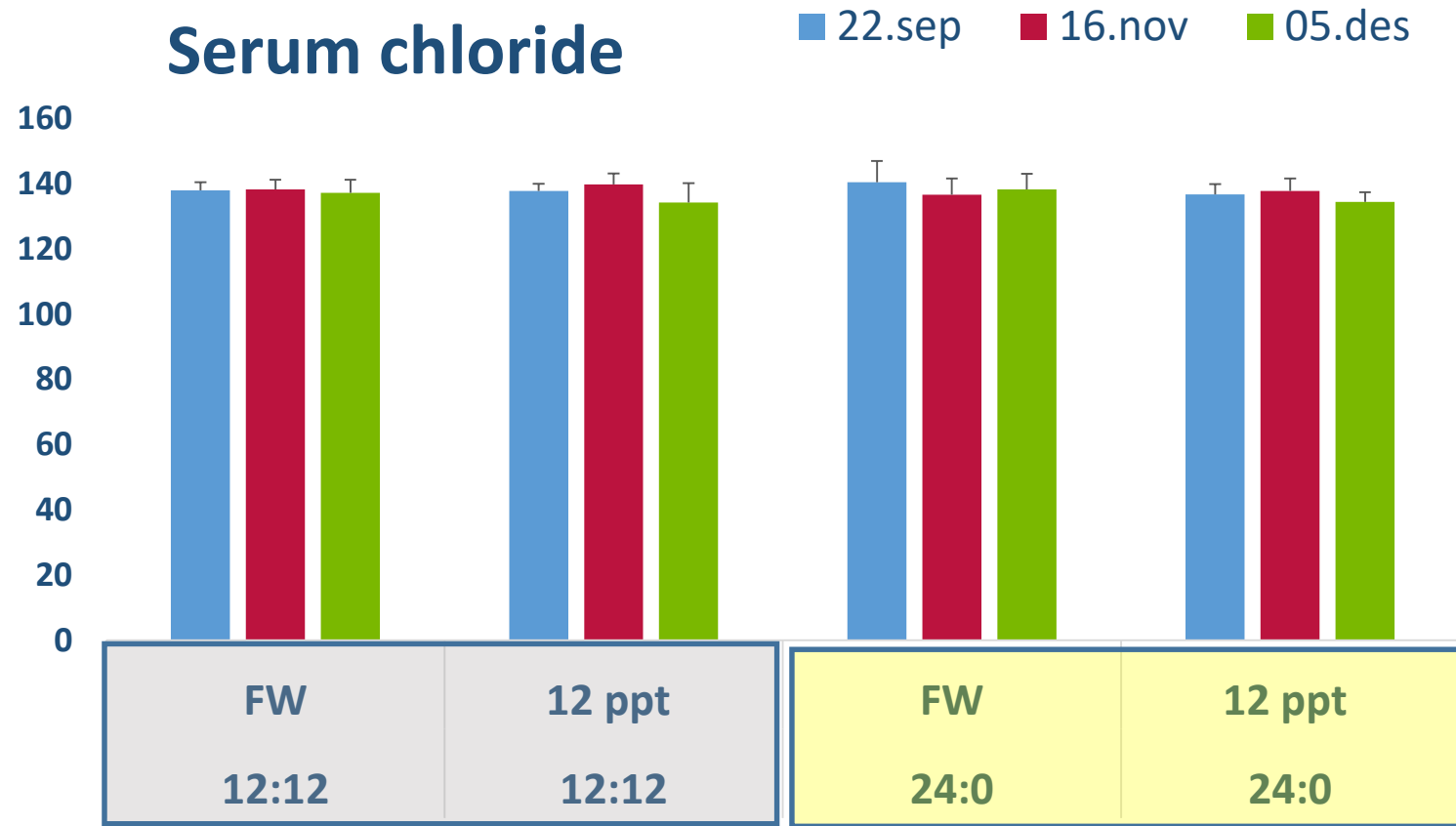
# Results during RAS stage: Seawater tolerance



- NKA activity decreased during fall in all treatments
- NKA akt. were not sign. different among treatments in late September
- In late November, NKA levels were higher in fish given a winter signal
- No significant effect of salinity

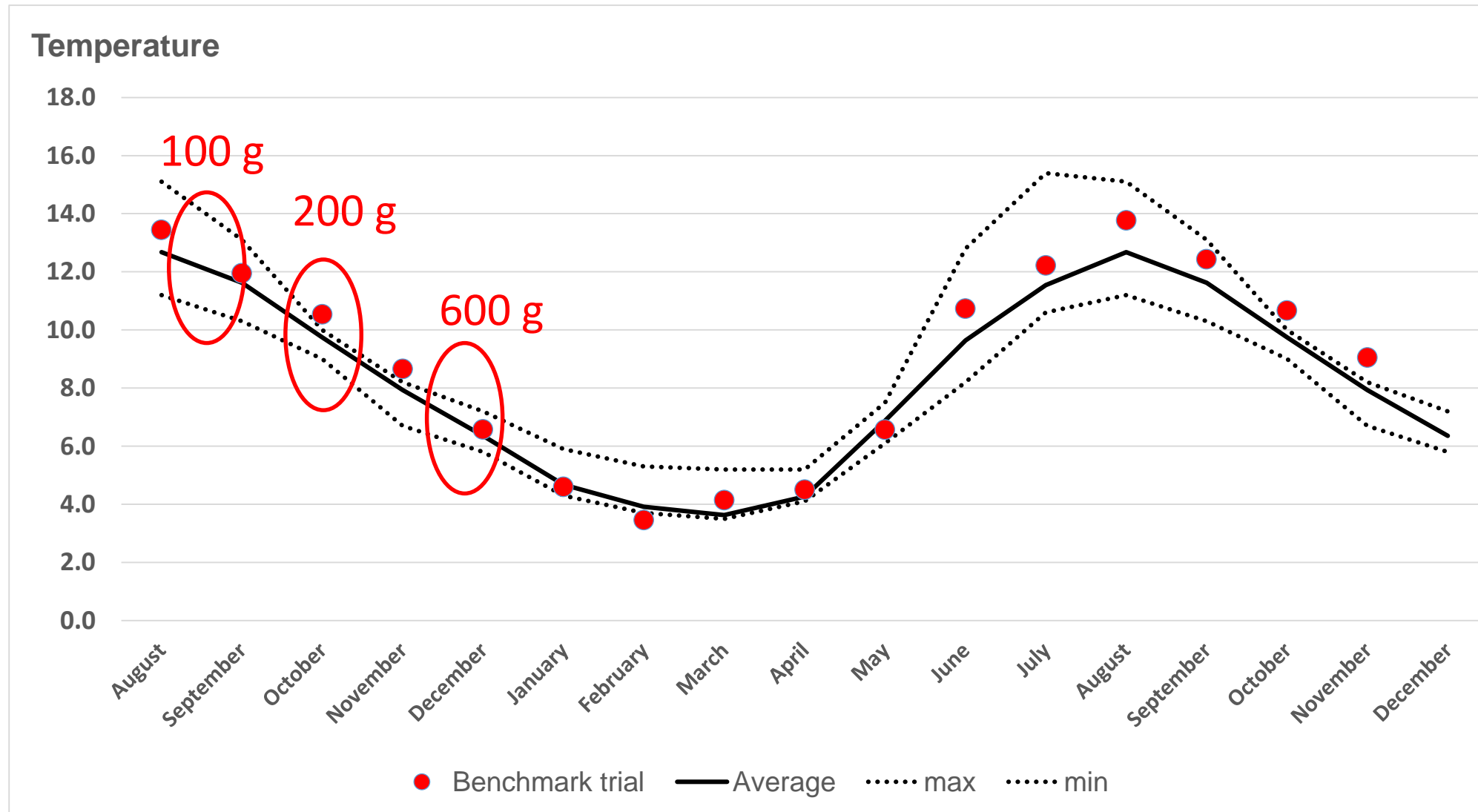
(Analysed by Pharmaq Analytic)

# Sea water tolerance tests (72h at 34 ppt )



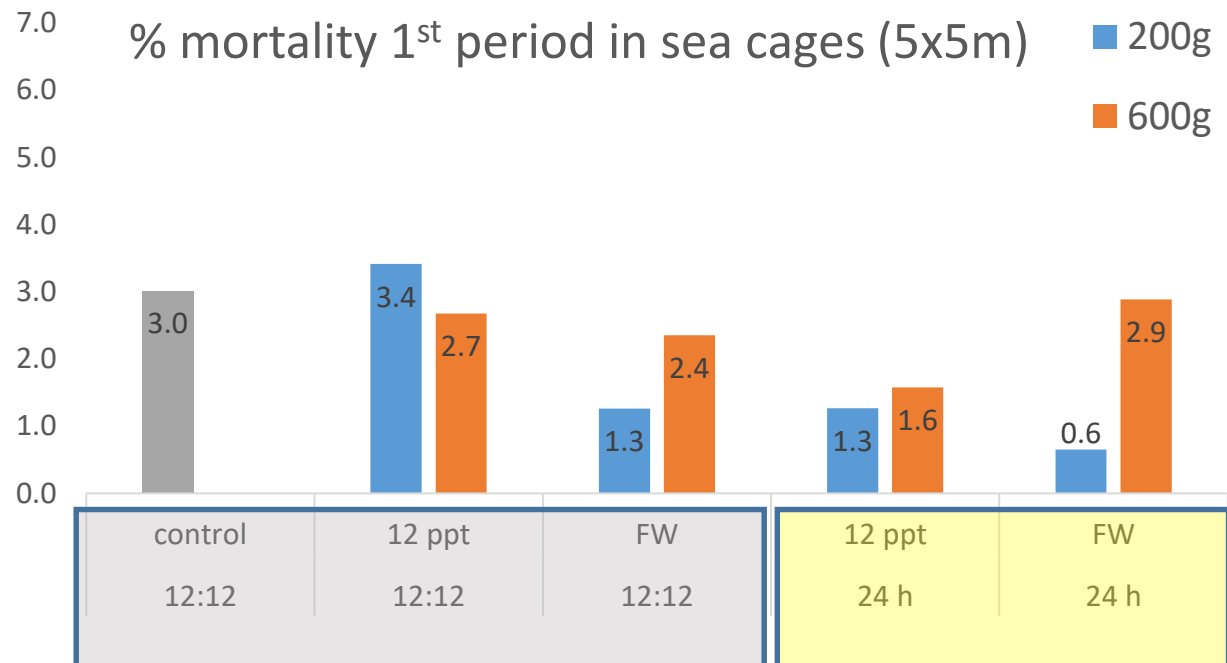
- No significant effects of treatment on serum levels of Cl, Na and Mg
- No mortality

# Results from the seawater phase at Gifas



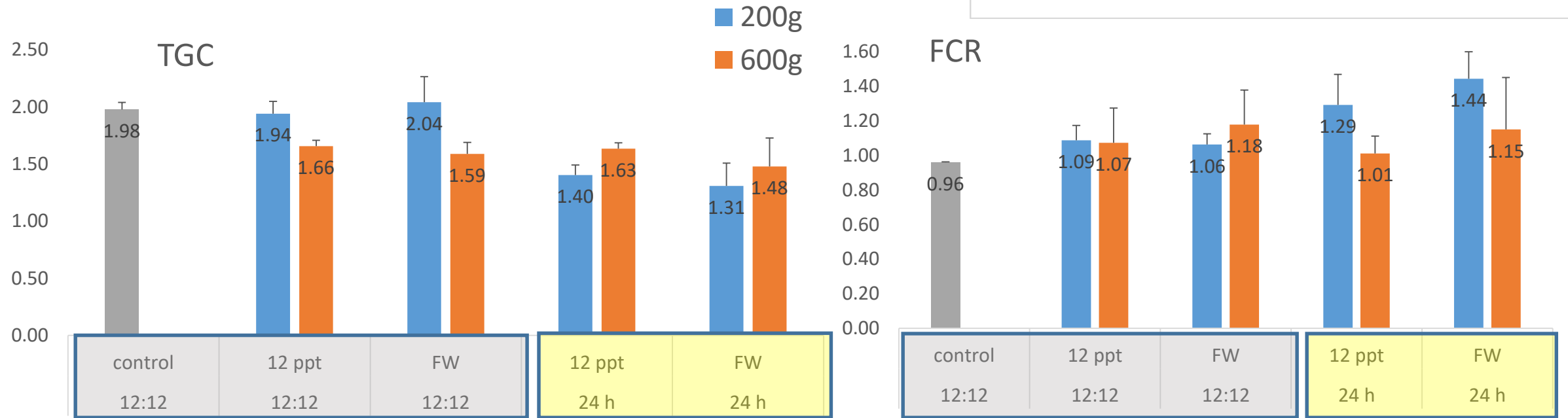
# Mortality first 5 weeks after transfer

- Low mortality the first 5 weeks after sea transfer
- No sign. effects of treatment
- Fish were in good condition at transfer, no scale loss



# Performance the first 5 weeks in sea cages (5x5m)

## Growth and feed conversion ratio (FCR)

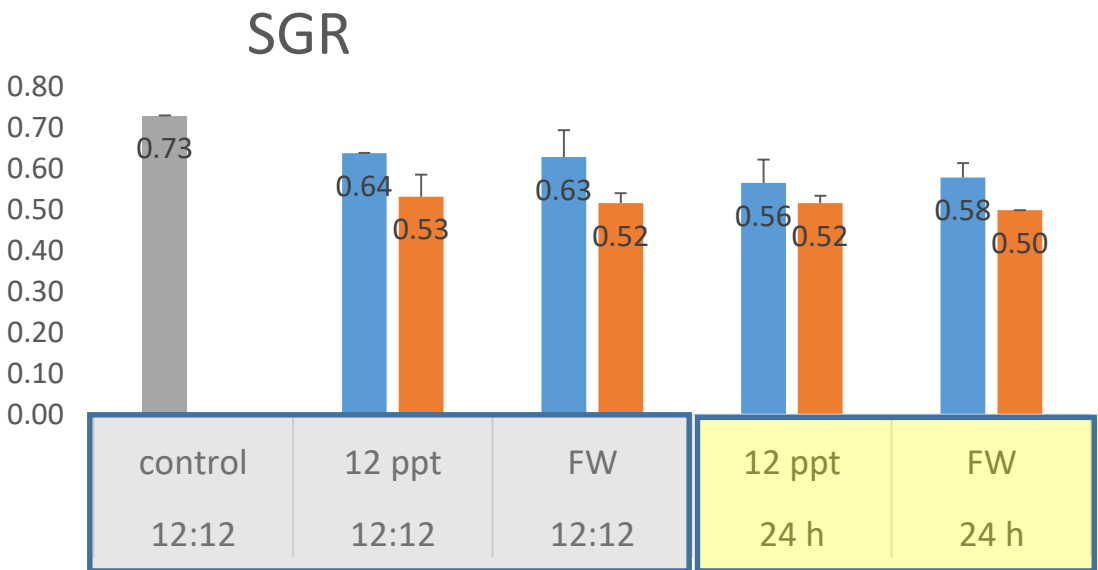
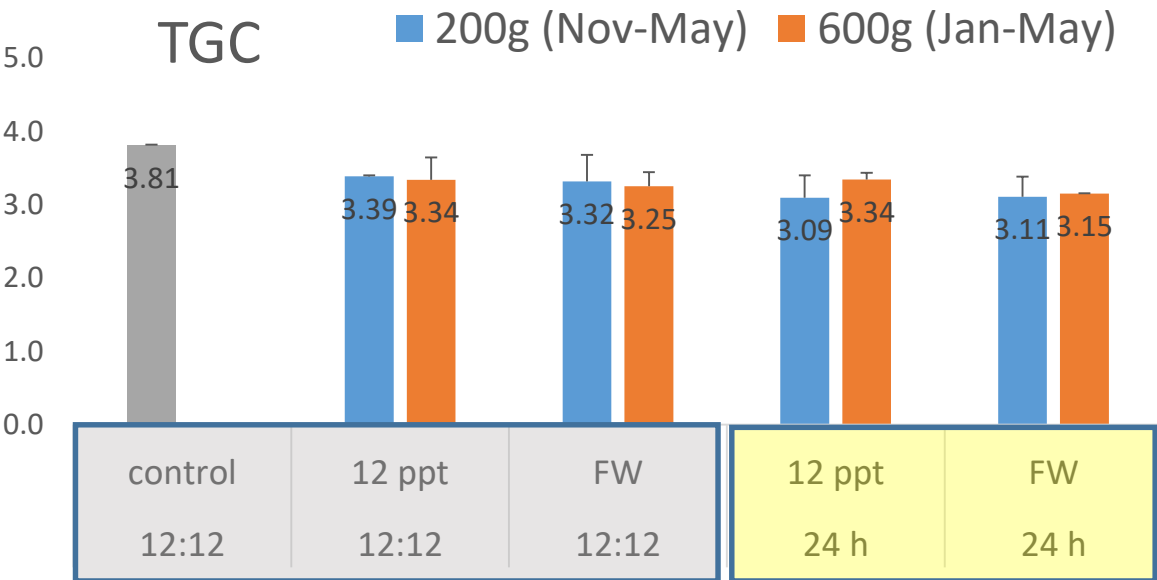
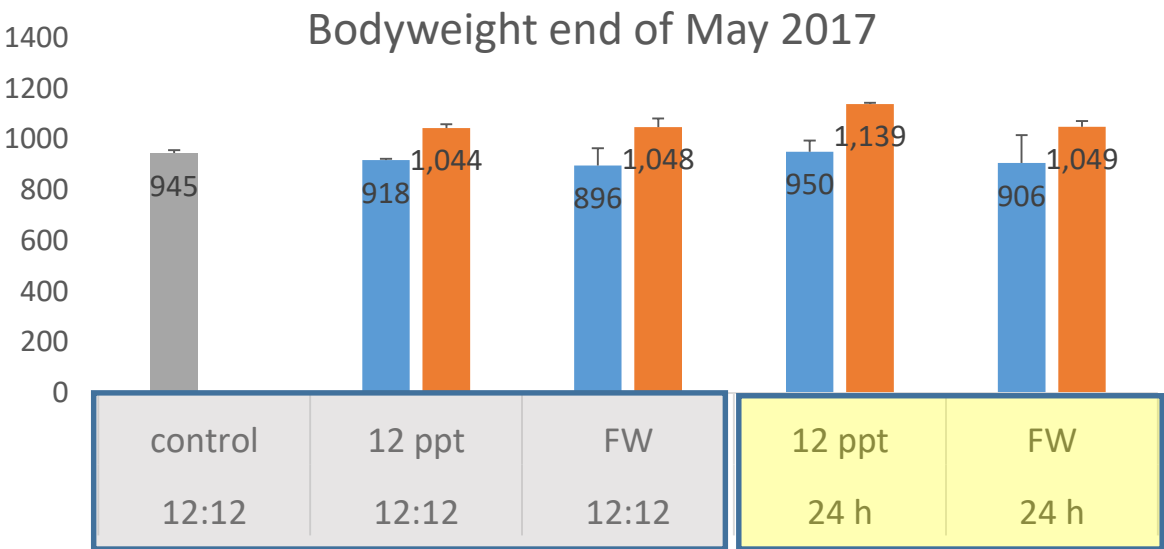


- 200g fish: 24:0 h light during the whole production period in RAS gave lower TGC and higher FCR, no sign. effect of salinity
- 600g fish: Positive effect of 12 ppt on TGC and FCR
- Negative correlation between TGC and condition factor at sea transfer

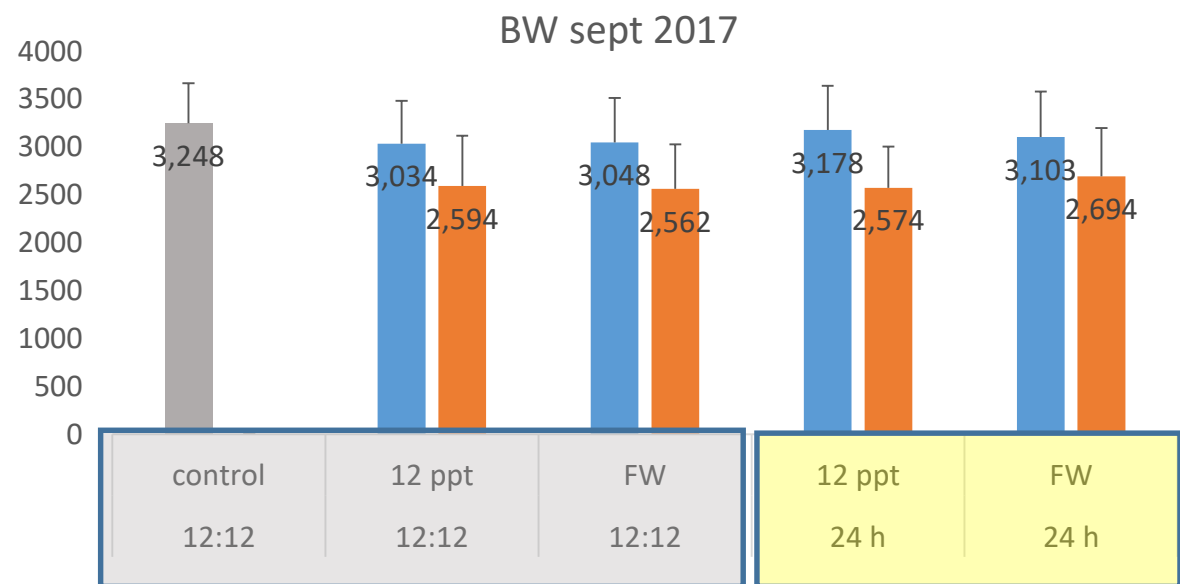
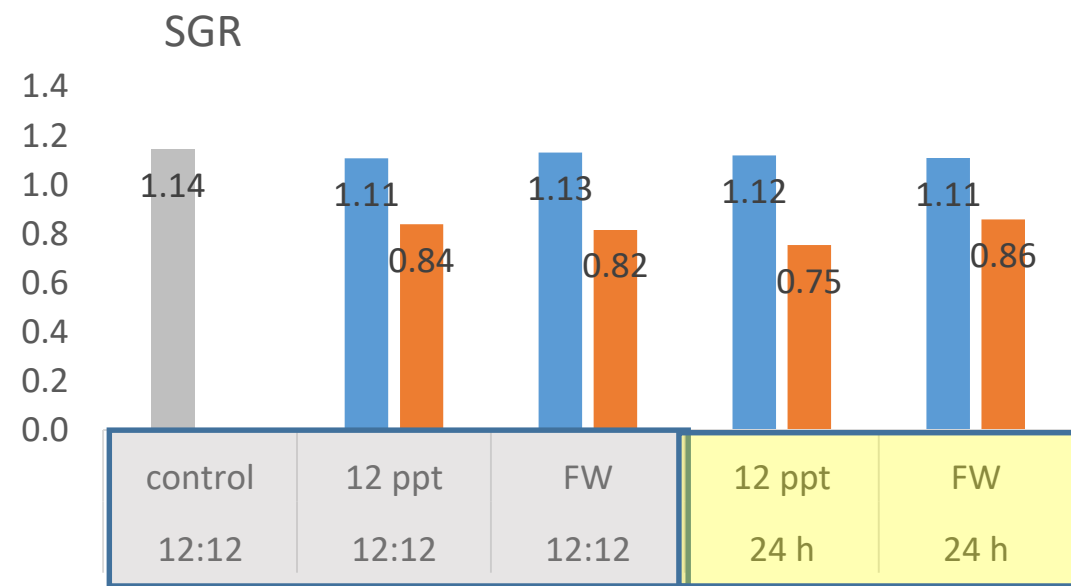
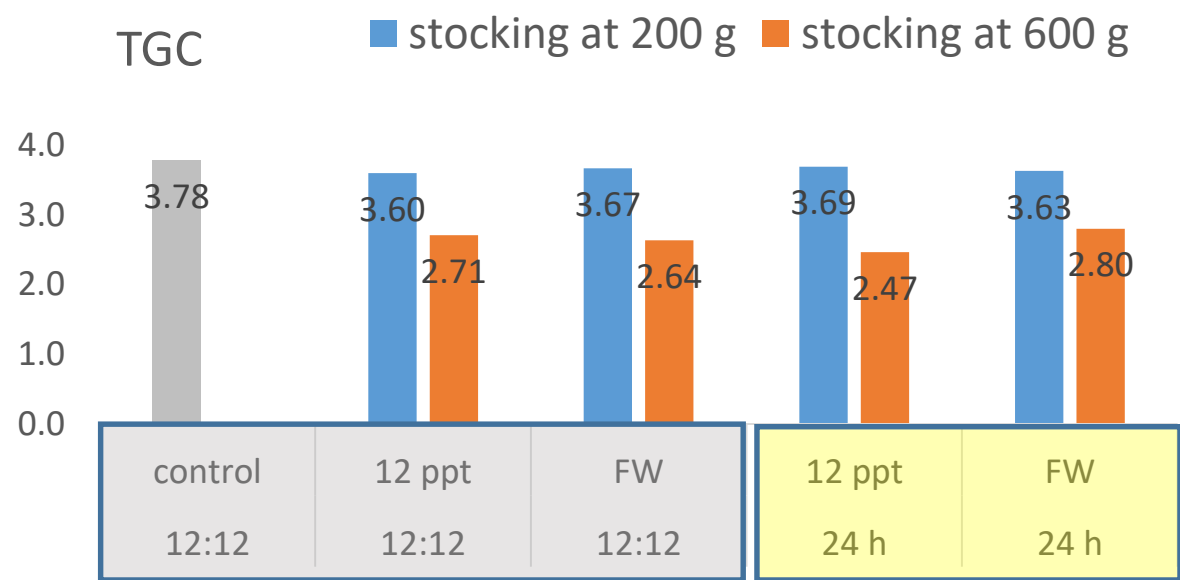


# Growth rate the 2<sup>nd</sup> period in the sea (11m cages)

- 600 g were largest in the end of May
- Highest SGR and TGC in controls,
- no sign. difference in TGC between 200 and 600g
- Higher SGR in 200g than in 600g
- Lack of winter signal gave lower growth in 200g fish, but not in 600g fish
- No sign. effect of salinity on growth rate



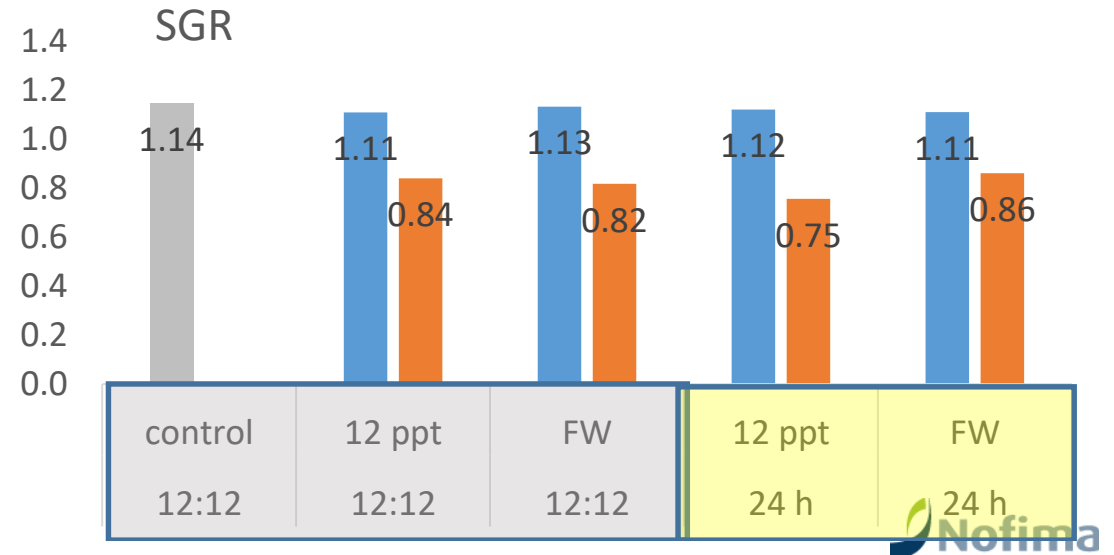
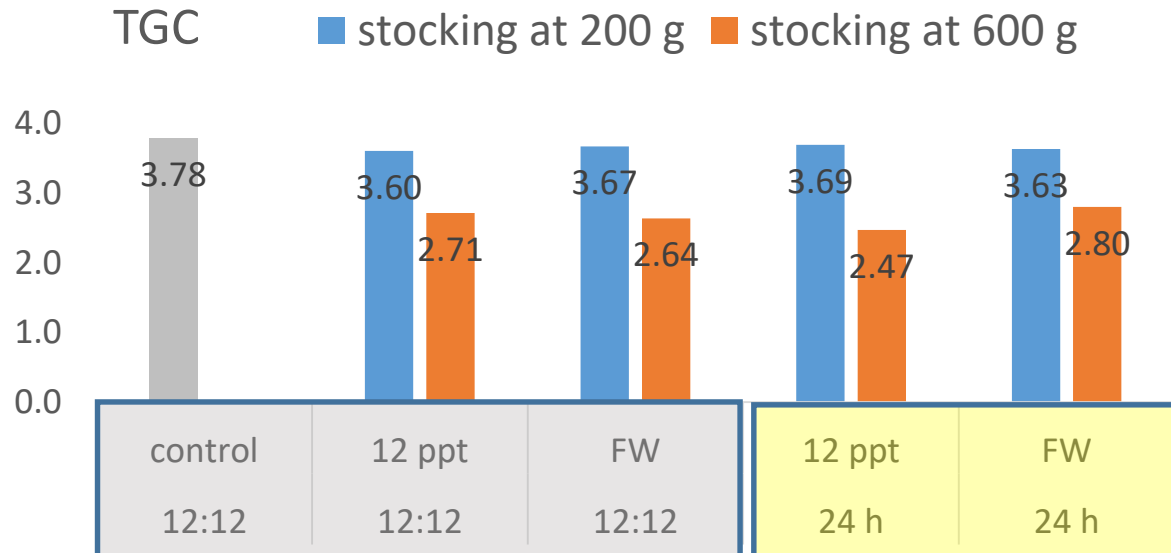
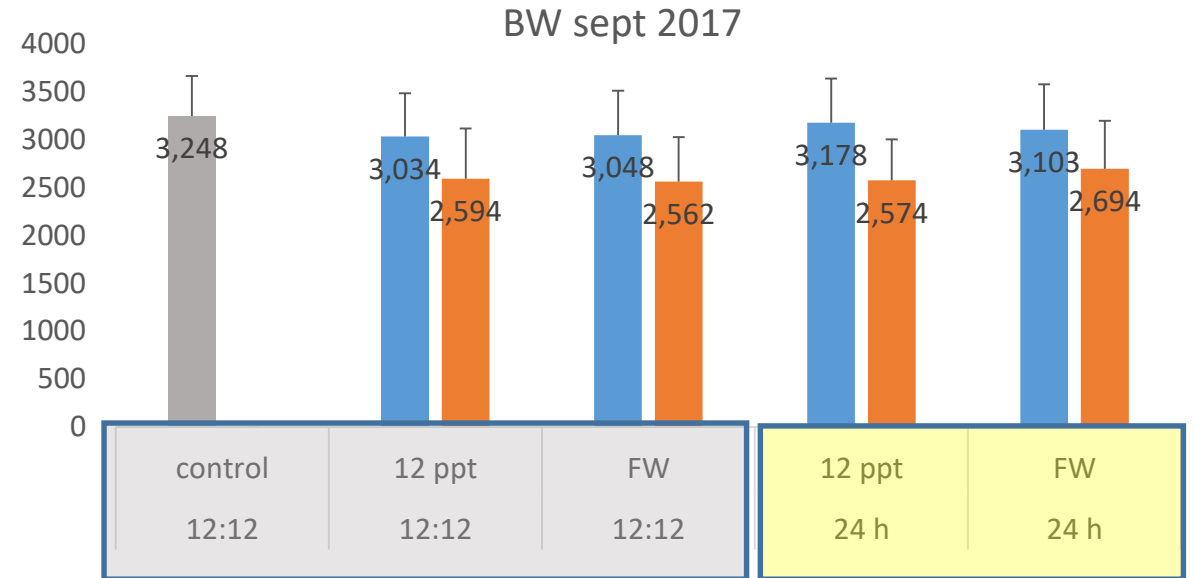
# Growth in sea cages 3<sup>rd</sup> period in the sea (May-Sept 2017)



- control > 200 g > 600 g,
- Salinity : NS, Light: NS

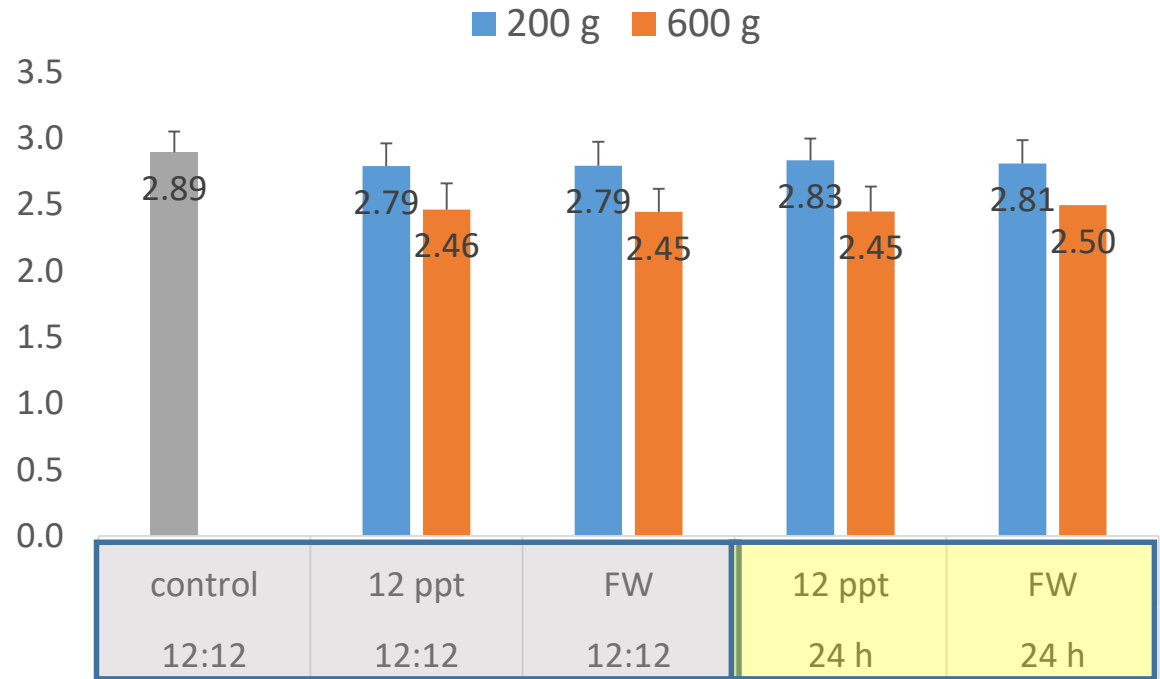
# Growth 3<sup>rd</sup> period in the sea (May-Sept 2017)

- Controls were largest in late september!
- TGC and SGR: control > 200 g >> 600 g
- Salinity : NS, Light: NS

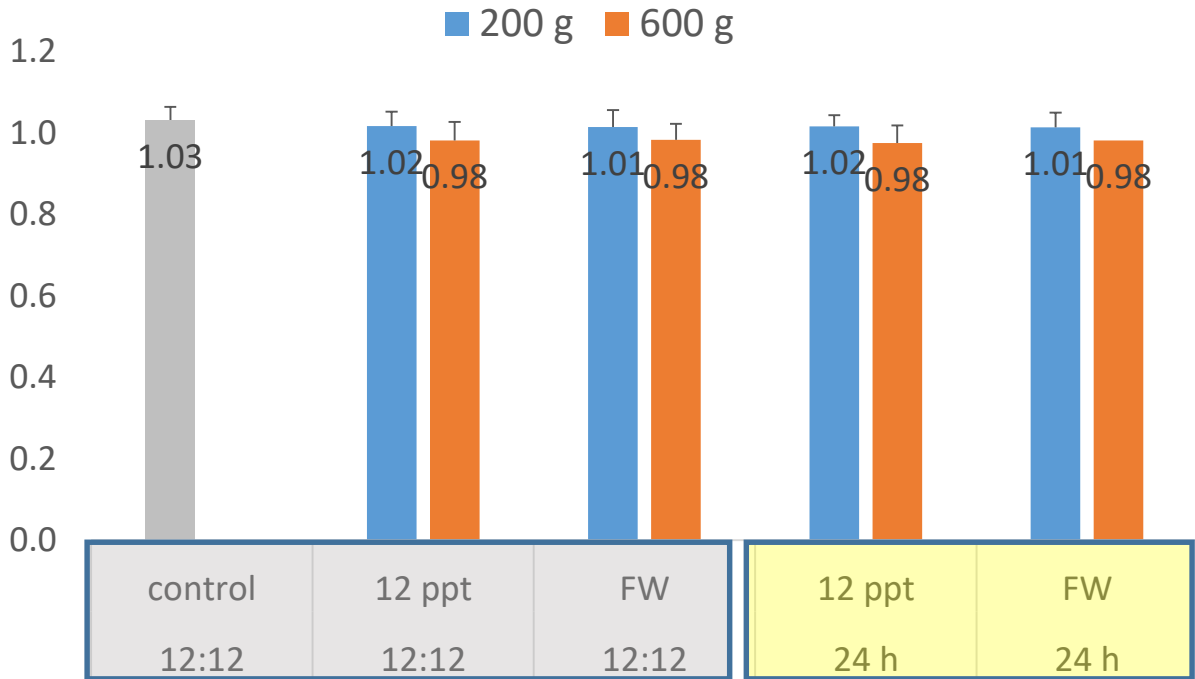


# Growth rate overall (RAS + sea cages) from June 2016 to Sept 2017 (30-3000g):

TGC from June 2016-Sept 2017



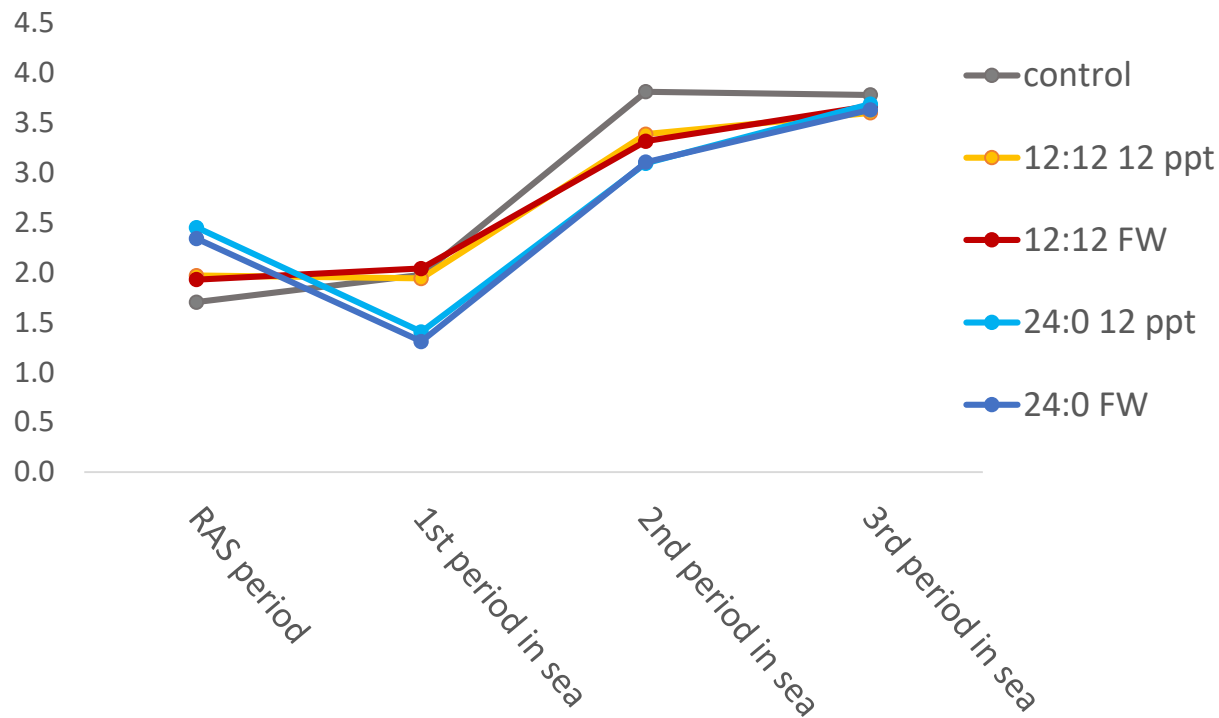
SGR Juni 2016-Sept 2017



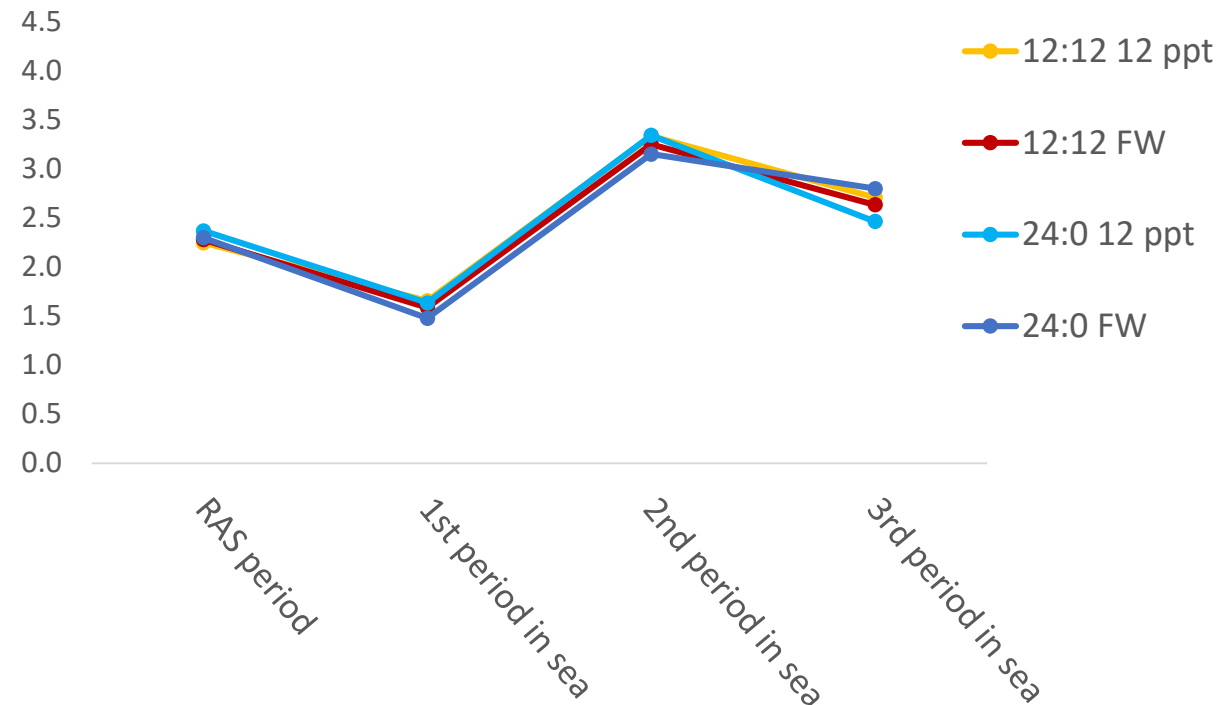
control > 200 g > 600, Salinity : NS, Light: NS

# Growth rates (TGC) of all groups during RAS and three periods after sea transfer (end of september 2017)

Control and ~200 g at transfer to sea



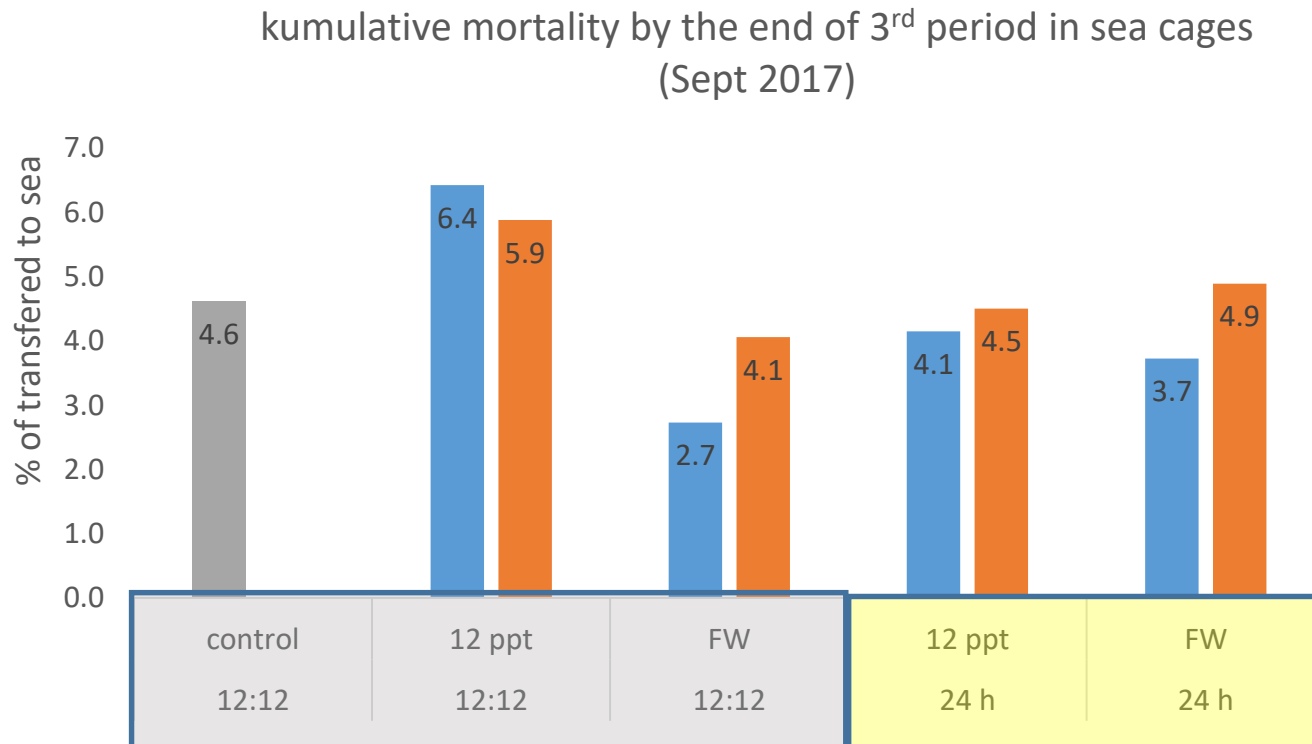
~600 g at transfer to sea





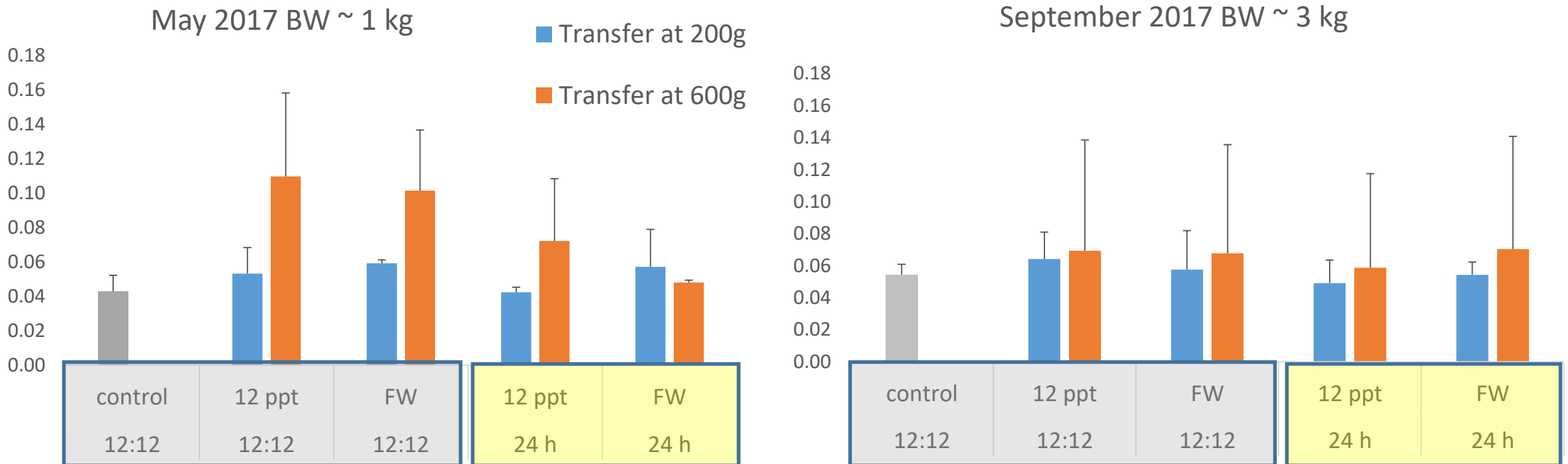
# Kumulative mortality in seawater

- Survival in the sea was between 93.6 and 97.3 % at ~3 kg in September 2017
- Highest mortality in 12:12, 12 ppt



# Male maturation

## GSI (Gonadosomatic index)



- No significant effect of light treatment or salinity in RAS on GSI
- Very few mature males observed during the trial, both in RAS and in the sea

# Conclusions so far:

- ✓ Better growth in RAS in the absence of a winter signal ( 24:0) and using 12 ppt
- ✓ However, lack of a winter signal reduced growth after transfer to seawater
- ✓ 12 ppt in RAS had positive effects on performance after transfer to sea
- ✓ Negative effect of high condition factor on growth after sea transfer
- ✓ All treatments gave sufficient seawater tolerance, also in 600g fish
- ✓ High survival in RAS and sea cages in all treatments
- ✓ No effects of treatment on male maturation, low incidence of mature males in RAS and seawater
- ✓ Fish transferred at 600g grew well initially in seawater, but had a reduced growth during summer compared to fish transferred at 100 and 200 g

# Thank you for your attention

## And thanks to partners in CtrlAQUA and the project group in Nofima

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