CO_2 tolerance of Atlantic salmon post-smolts in recirculating aquaculture systems

Vasco Mota*,

Tom Nilsen, Elizabeth Ytteborg, Grete Baeverfjord, Aleksei Krasnov, Jelena Kolarevic, Lars Ebbesson, Steven Summerfelt and Bendik Fyhn Terjesen

* Norwegian Institute of Food, Fisheries and Aquaculture Research – Nofima

vasco.mota@nofima.no

Problem definition

Fish exposed to high CO_2 shows:

- Lower: oxygen consumption, feed intake, growth
- Higher: Nephrocalcinosis (deposits in kidneys) & cataracts
- Impaired osmoregulation and blood acidosis
- Gene expression changes

Dissolved CO_2 accumulates in RAS

Recommendation for Atlantic salmon: 15 – 20 mg/L

Atlantic salmon CO_2 tolerance in RAS is unknown

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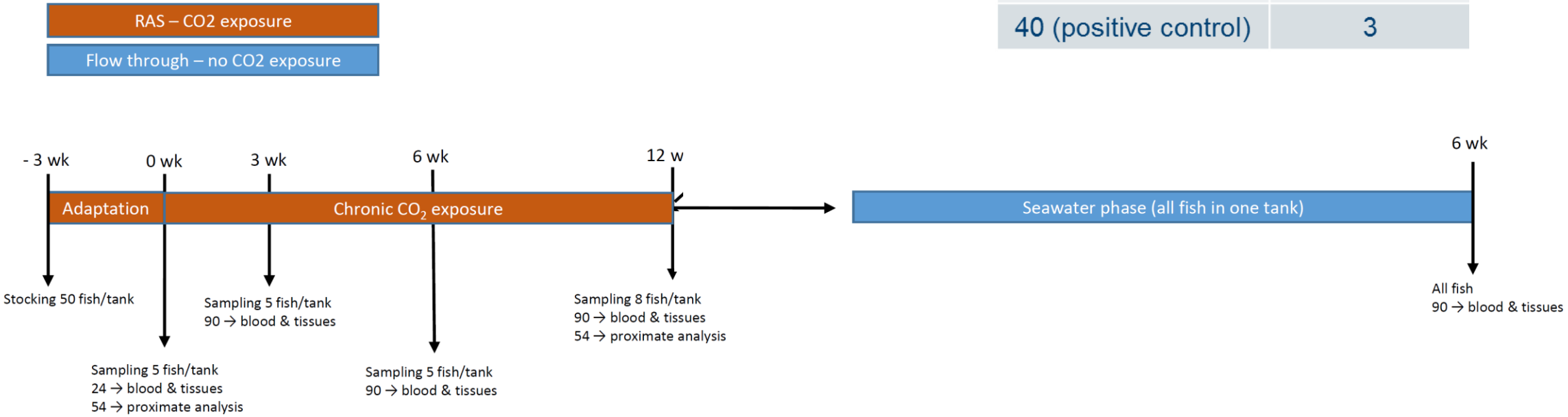
OBJECTIVE

Carbon dioxide tolerance of Atlantic salmon post-smolts in RAS

Experimental design

CO_2 (mg/L)	Replicates (n)
5 (negative control)	3
12	3
19	3
26	3
33	3
40 (positive control)	3



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Experimental system

Water quality

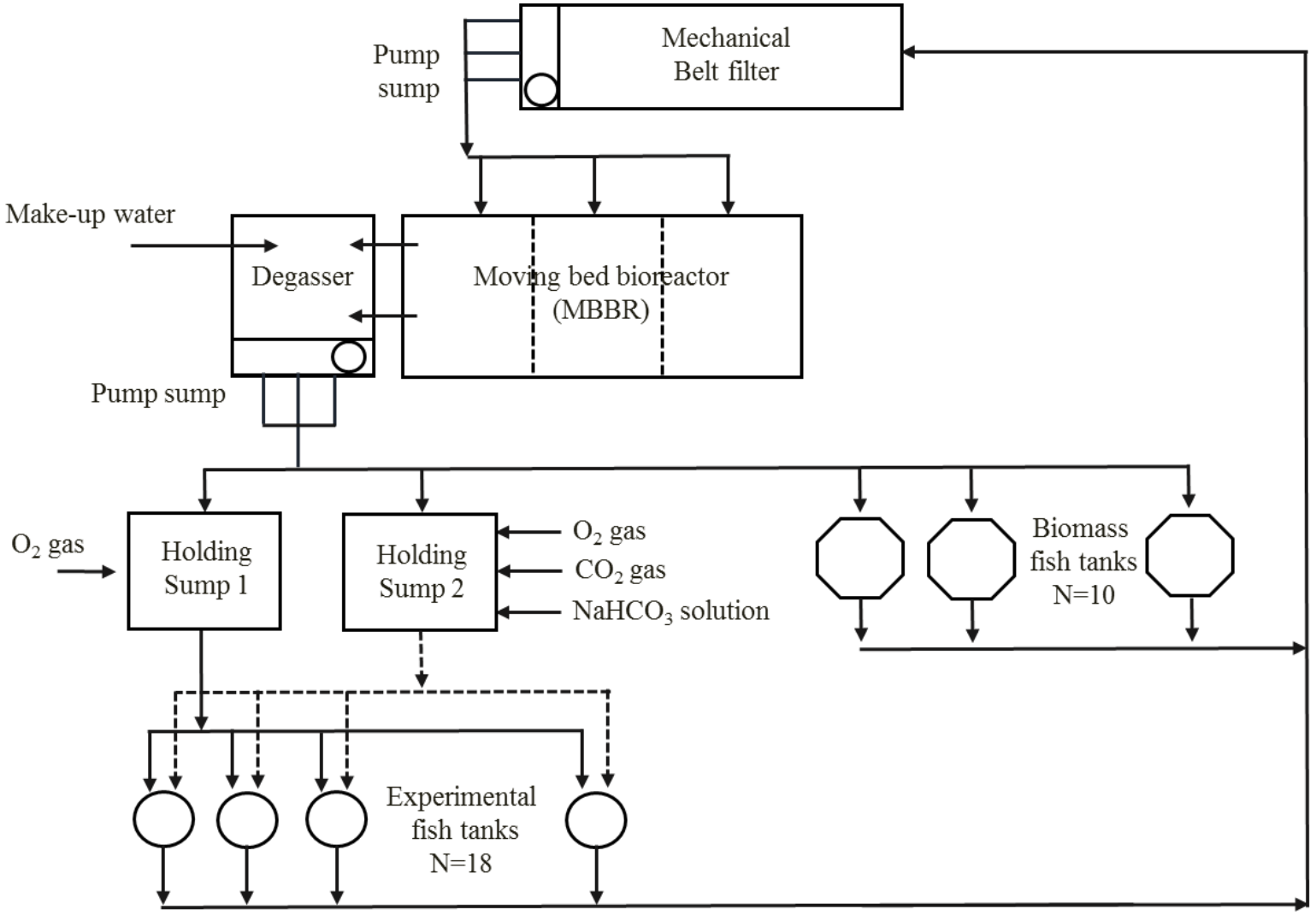
Oxygen >85 %

Salinity 12 ppt

Temperature 12 – 13 ˚C

pH 6.7 – 7.7

Alkalinity 116 – 165 mg/L



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R: health & welfare

No observed effects on:

- haematocrit
- glucose
- hepatosomatic Index
- eye cataracts
- welfare score (skin & fins)
- nephrocalcinosis

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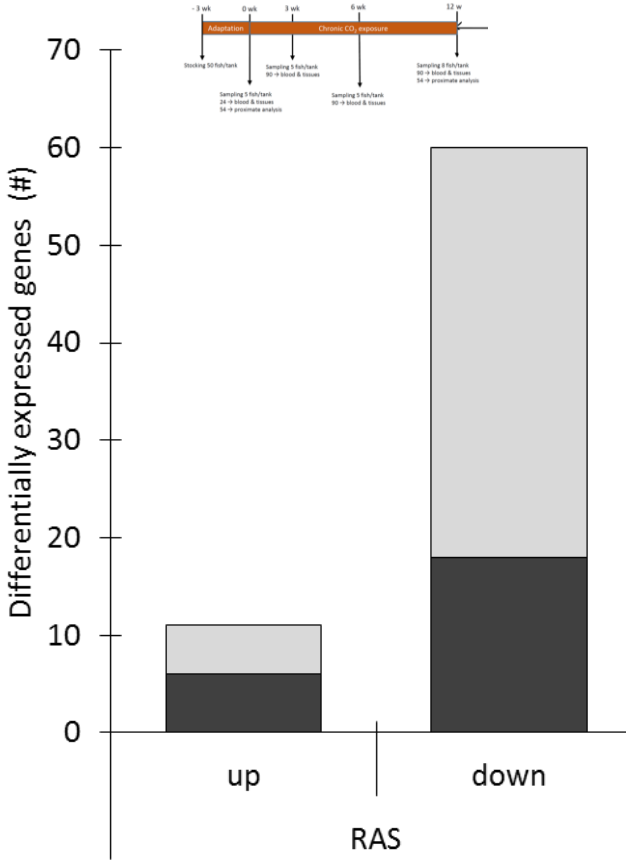
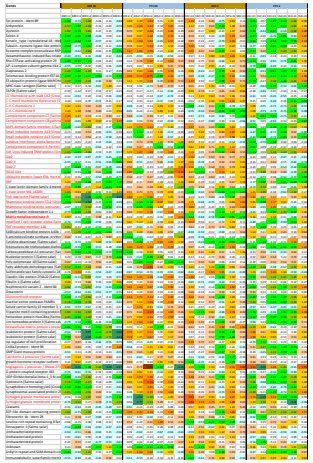
R: gene expression microarray

Gill: low DEG / gene suppression in RAS



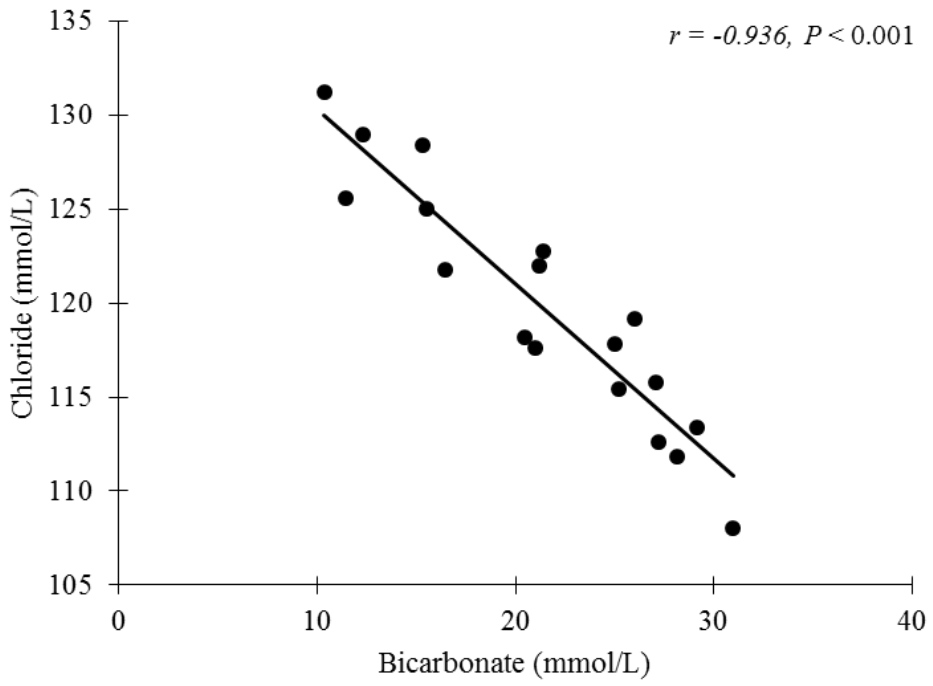
Immnune genes

Other genes

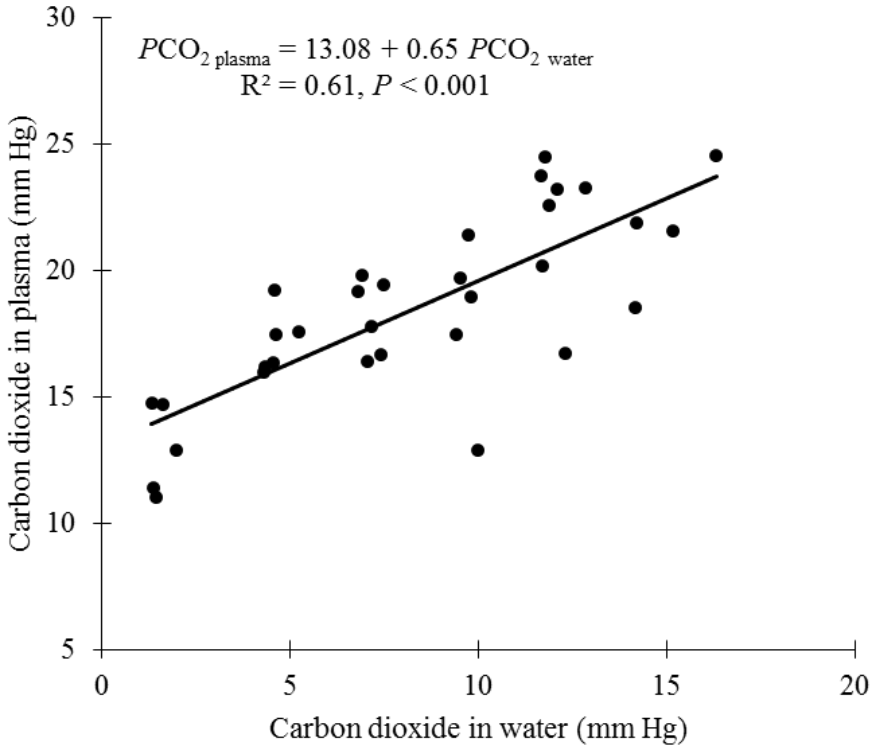


R: physiology

Negative correlation
choride vs. bicarbonate



Positive regression
CO_2 plasma vs. water



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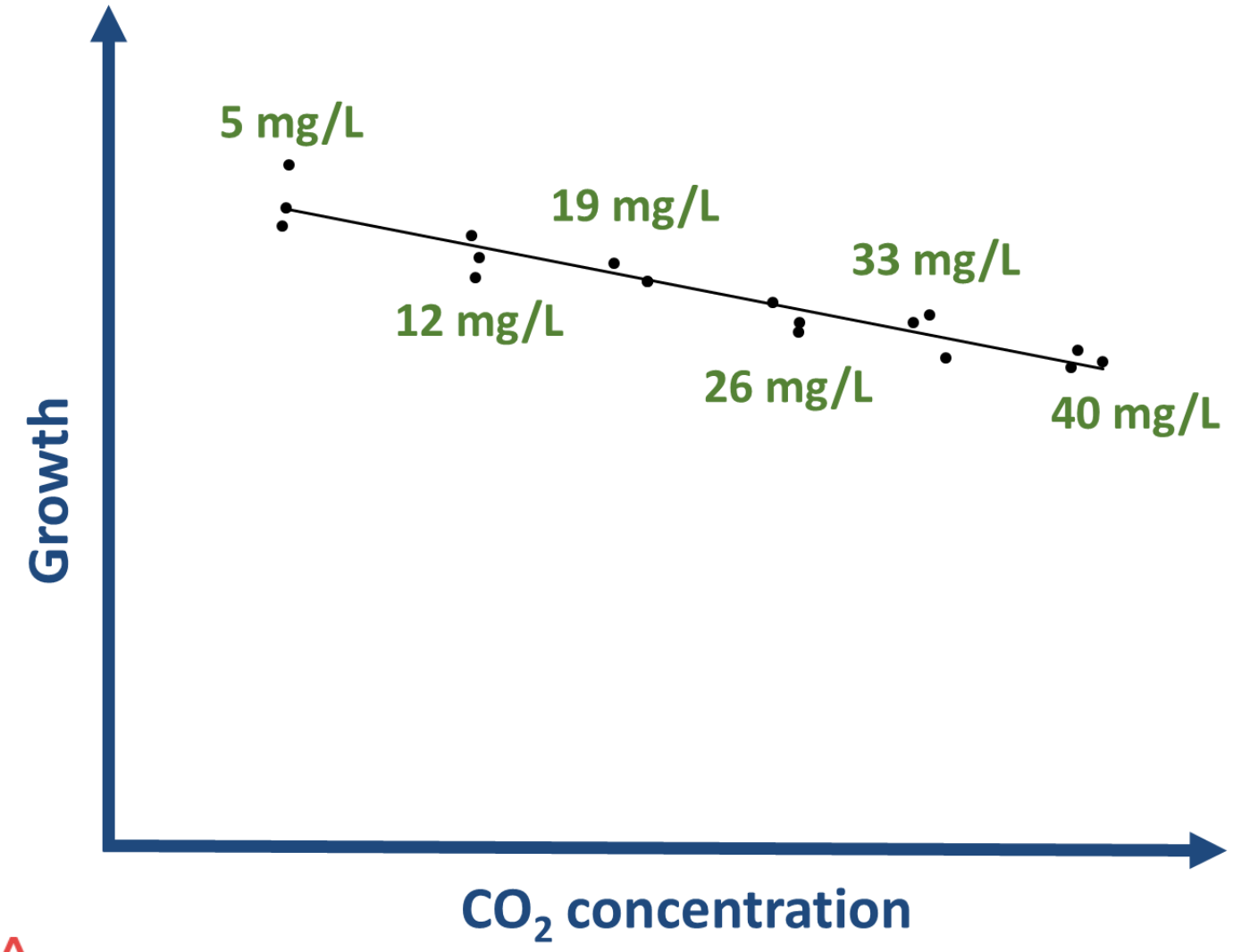
R: fish growth



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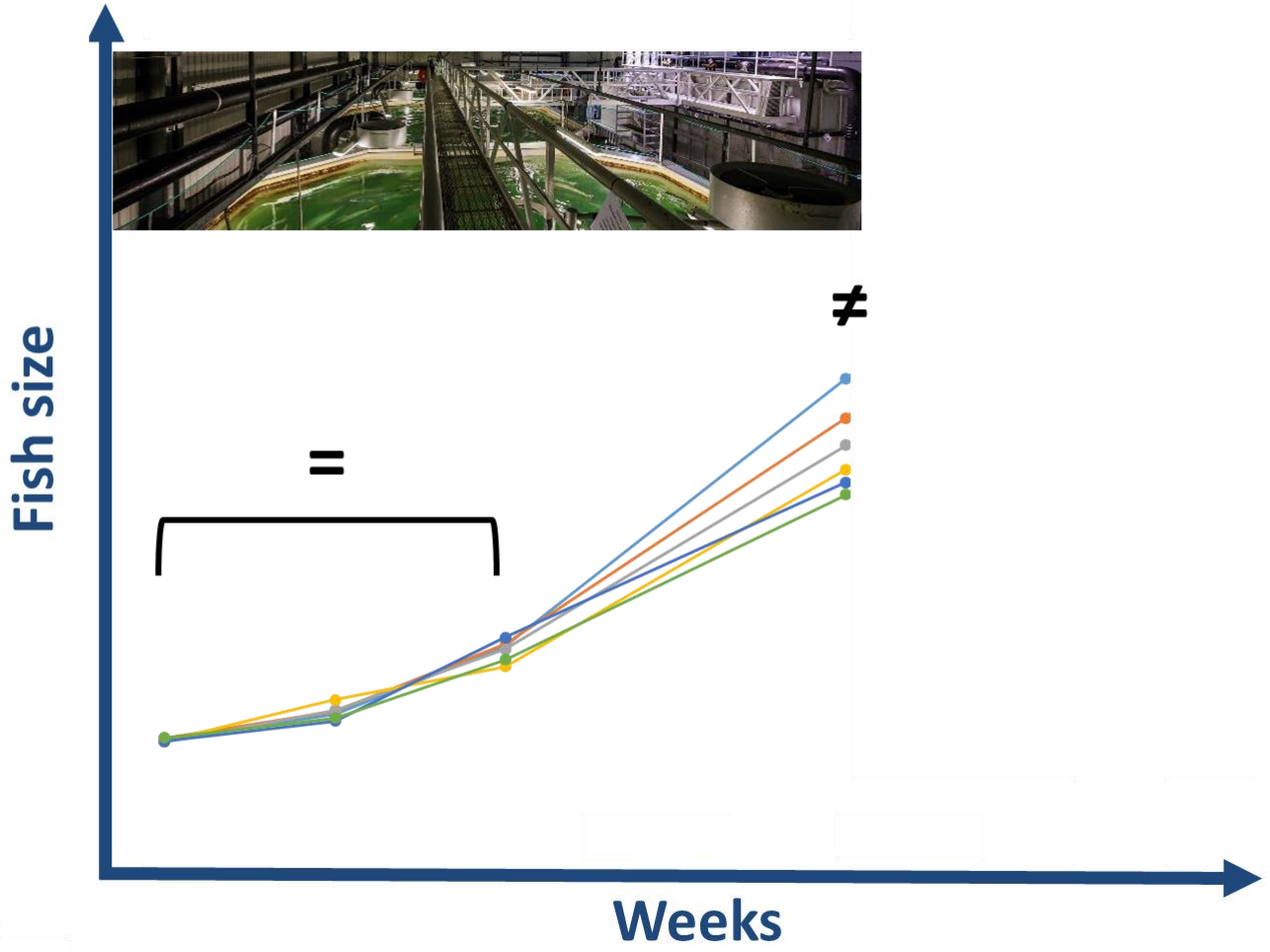
R: fish body weight



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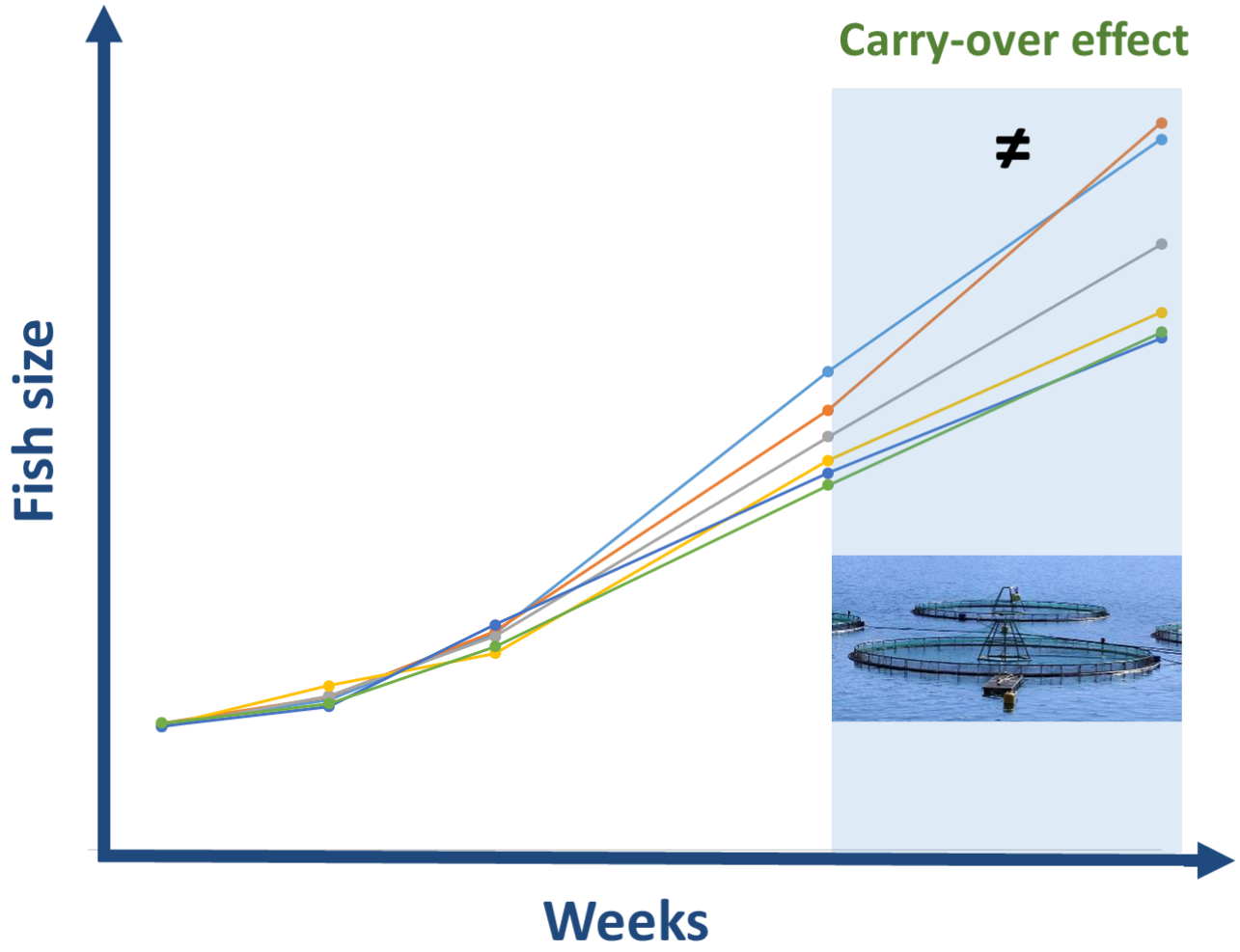
R: fish body weight



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RAPPORT

Conclusions

- no mortalities, cataracts, nephrocalcinosis or poor external welfare observed in fish exposed to CO_2 from 5 – 40 mg/L
- the highest non-observed effect concentration for several ions and growth was 5 mg/L

Three take home messages

- Atlantic salmon very resilient to high CO_2
- CO_2 has a growth penalty, and this penalty starts at lower concentrations than previously reported (<12 mg/L)
- early production conditions have a carry-over effect on fish performance at later phases

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Thank you for your attention.

Vasco Mota

Contact: vasco.mota@nofima.no

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