



INTELLIRAS

Some results from a project on precision fish farming (PFF) in recirculation aquaculture systems (RAS)

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Recirculating aquaculture system (RAS) farm

Foto: <https://akvakulturfakta.dk/hvad-er-et-recirkuleringsanlaeg/>

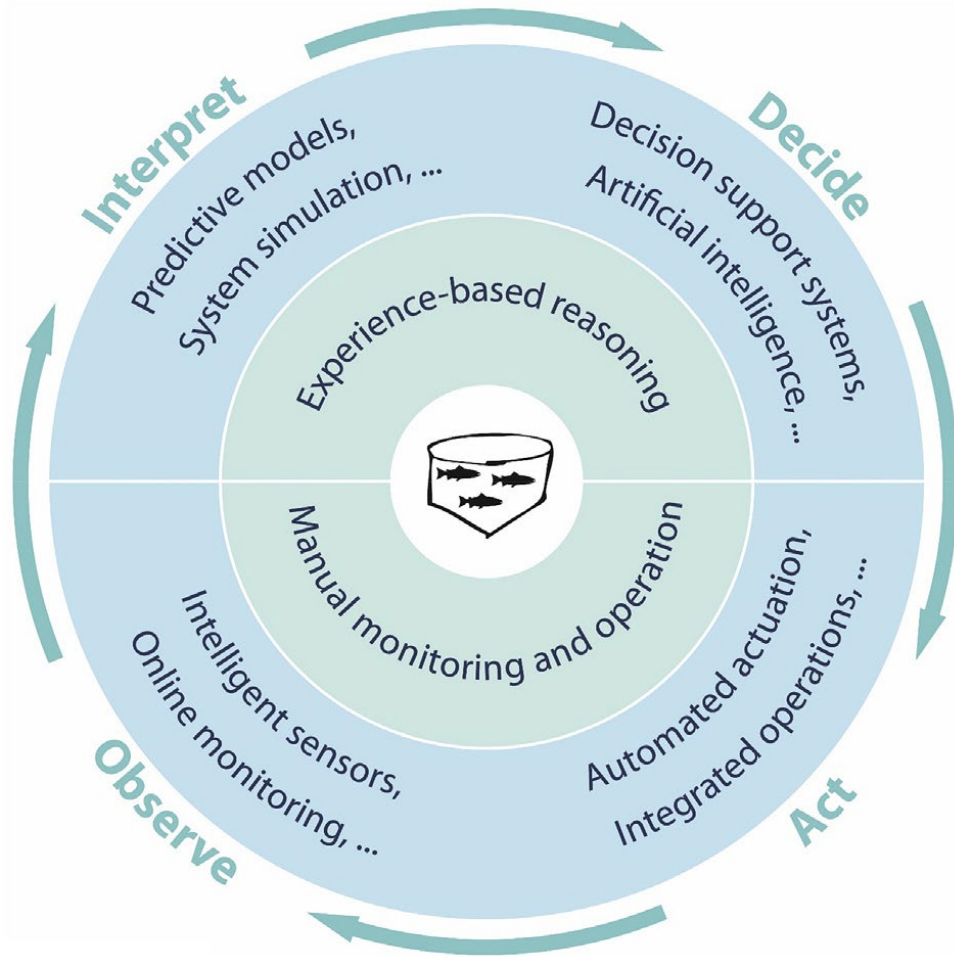
***) Intelligent farming and health control in land-based recirculating aquaculture systems**

Study period: 1 Mar 2021 – 1 Sep 2024

IntelliRAS is supported by the Nordic Research and Innovation Programme for Sustainable Aquaculture under NordForsk (grant no. 104876); <https://www.nordforsk.org>



PRECISION FISH FARMING (PFF)



WP3 aim (Mogens Agerbo Krogh, AU, WPlleader)

- Modelling and setting up systems for disease monitoring and PFF
- ... today: specifically monitoring and predicting mortality of rainbow trout.

The basic principles of Precision Fish Farming (PFF)

Fig. 1 from Føre et al. (2017)

Precision fish farming: A new framework to improve production in aquaculture

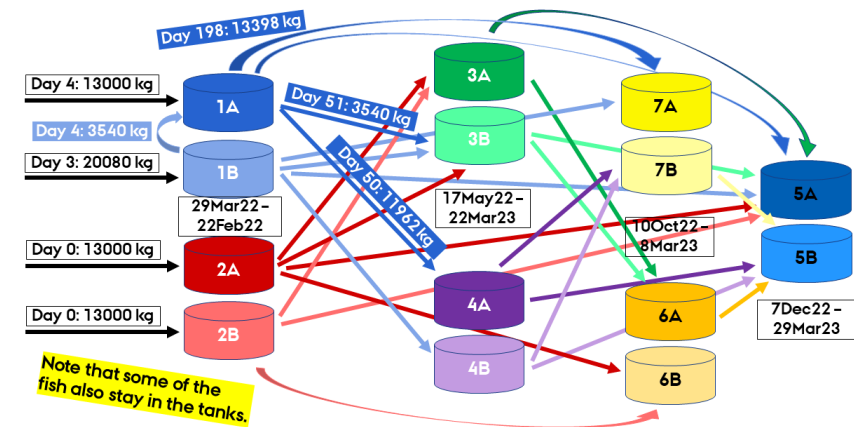
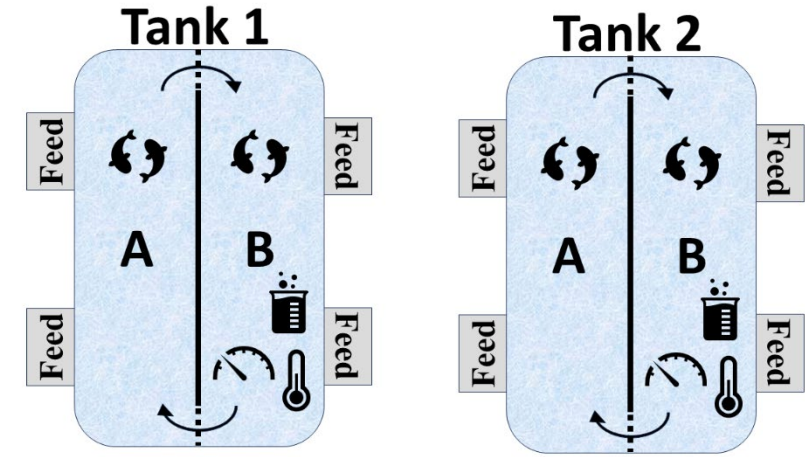
BiosystemsEngineering, 173, 176-193

<https://doi.org/10.1016/j.biosystemseng.2017.10.014>

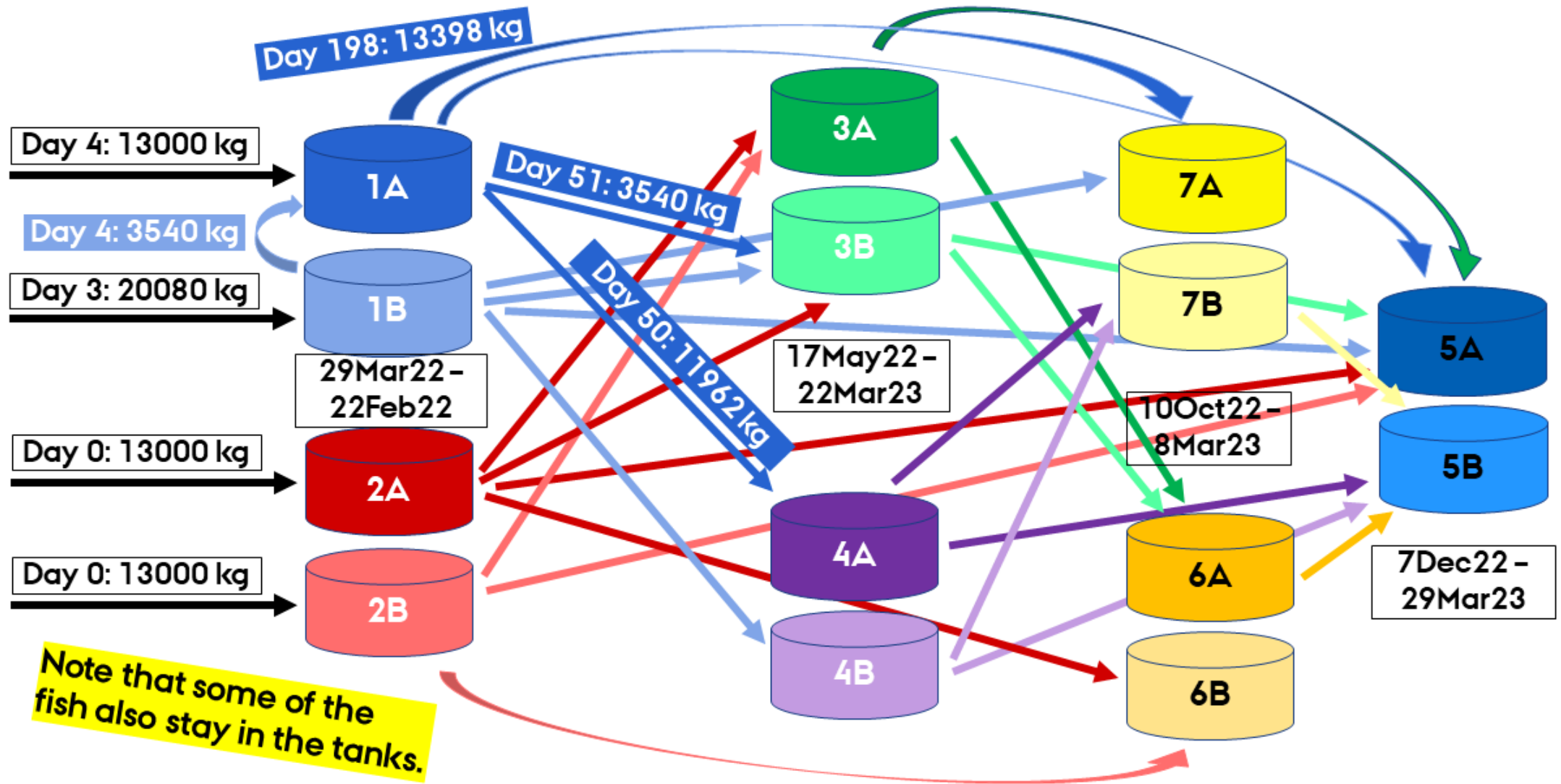
A SCANDINAVIANLAND-BASED RAINBOW TROUT RAS FARM

With a large degree of recirculation, filters and use of ground water.

- 12 concrete tanks
 - Each divided into two 532 m³ sub-tanks
- Feeders filled once each day
 - Providing feed when activated by fish
- Production cycle (on this farm)
 - Approx. 1 year
 - 350-400g when inserted
 - 3500-4000 g when slaughtered
- Batch
 - 29 March 2022 to 29 March 2023
 - Using 7 tanks for the last months



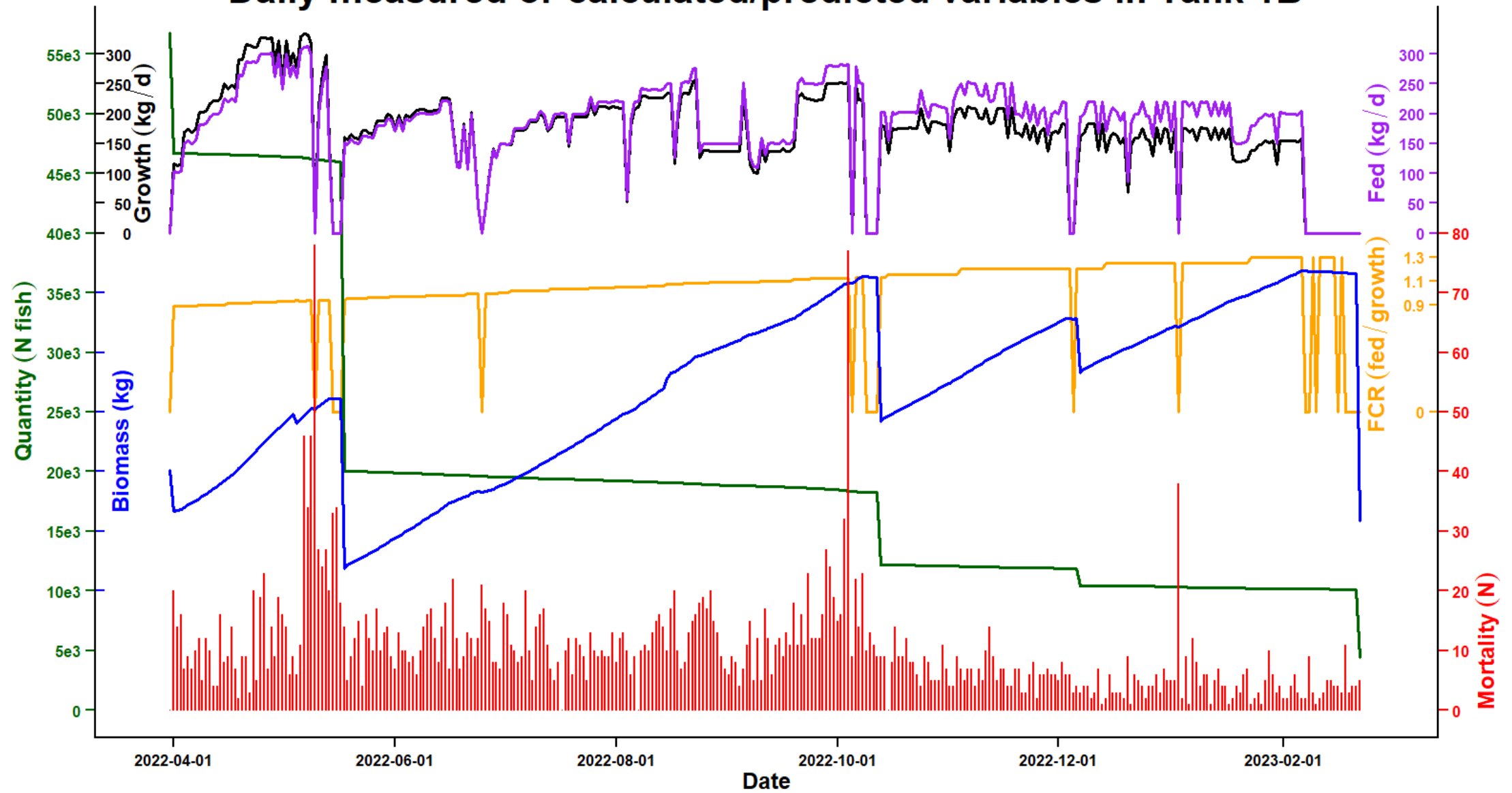
MOVEMENT OF FISH IN A BATCH AS THEY GROW



DAILY MEASURED OR CALCULATED/PREDICTED VARIABLES

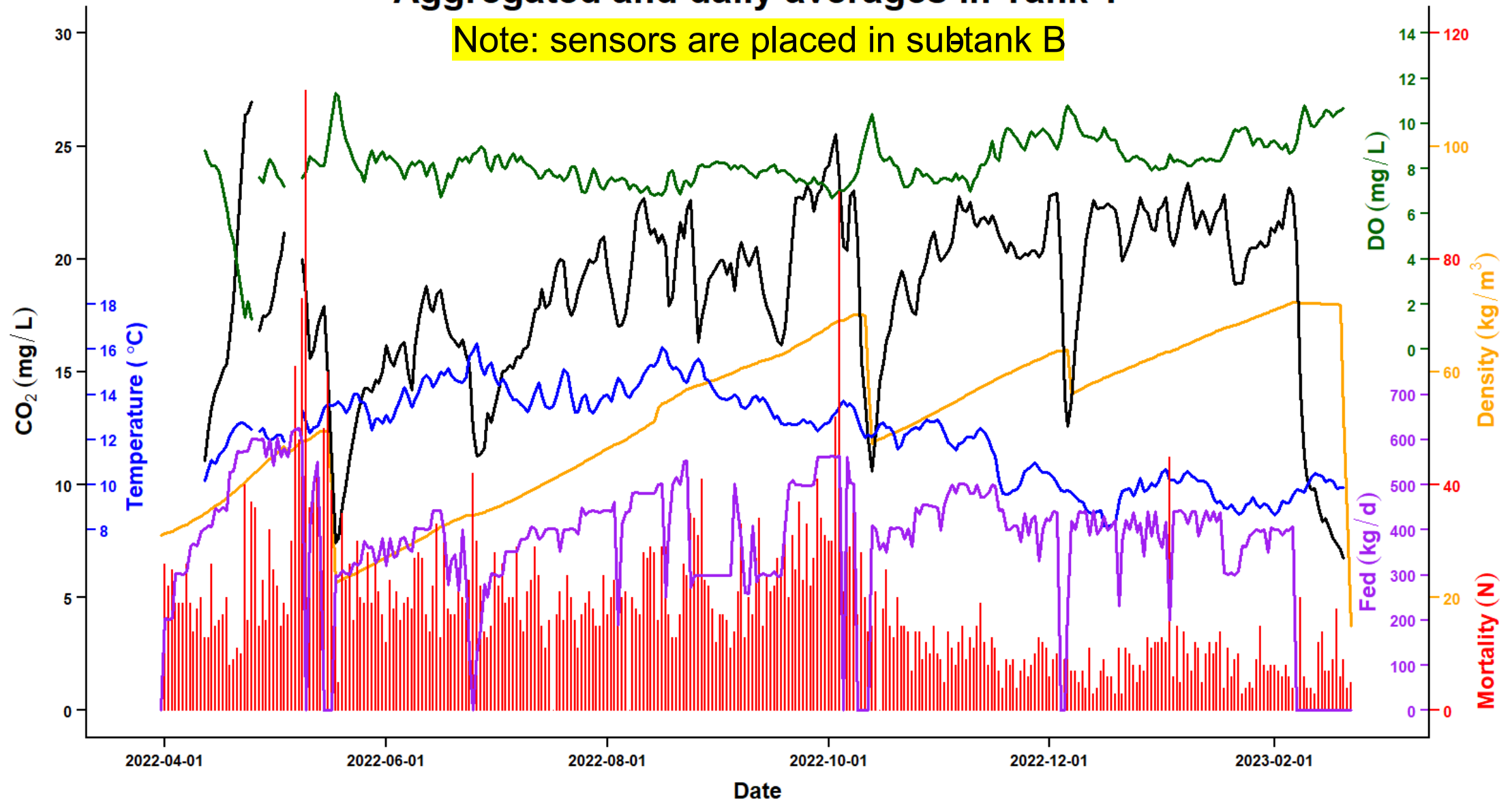
- **Growth** (kg/day) of biomass in tank on day d : $G_d = \frac{F_d}{FCR_d}$
 - based on feed fed (F) and a feed conversion ratio (FCR)
- **Biomass** (kg) of tank on day d : $B_d = B_{d-1} + I_d - R_d + G_d - M_d \cdot W_{d-1}$
 - based on growth (G) and biomass of counted dead fish (M) on day d using the calculated average weight (W) from day $d - 1$
 - and inserting (I) or removing (R) biomass when fish are moved
- **Quantity** (N fish): $Q_d = Q_{d-1} - M_d + \frac{I_d - R_d}{W_{d-1}}$
- **Density** of fish in the tank: $D_d = \frac{B_d}{V}$
 - where $V = 532 \text{ m}^3$ is the volume of the (sub-)tank

Daily measured or calculated/predicted variables in Tank 1B



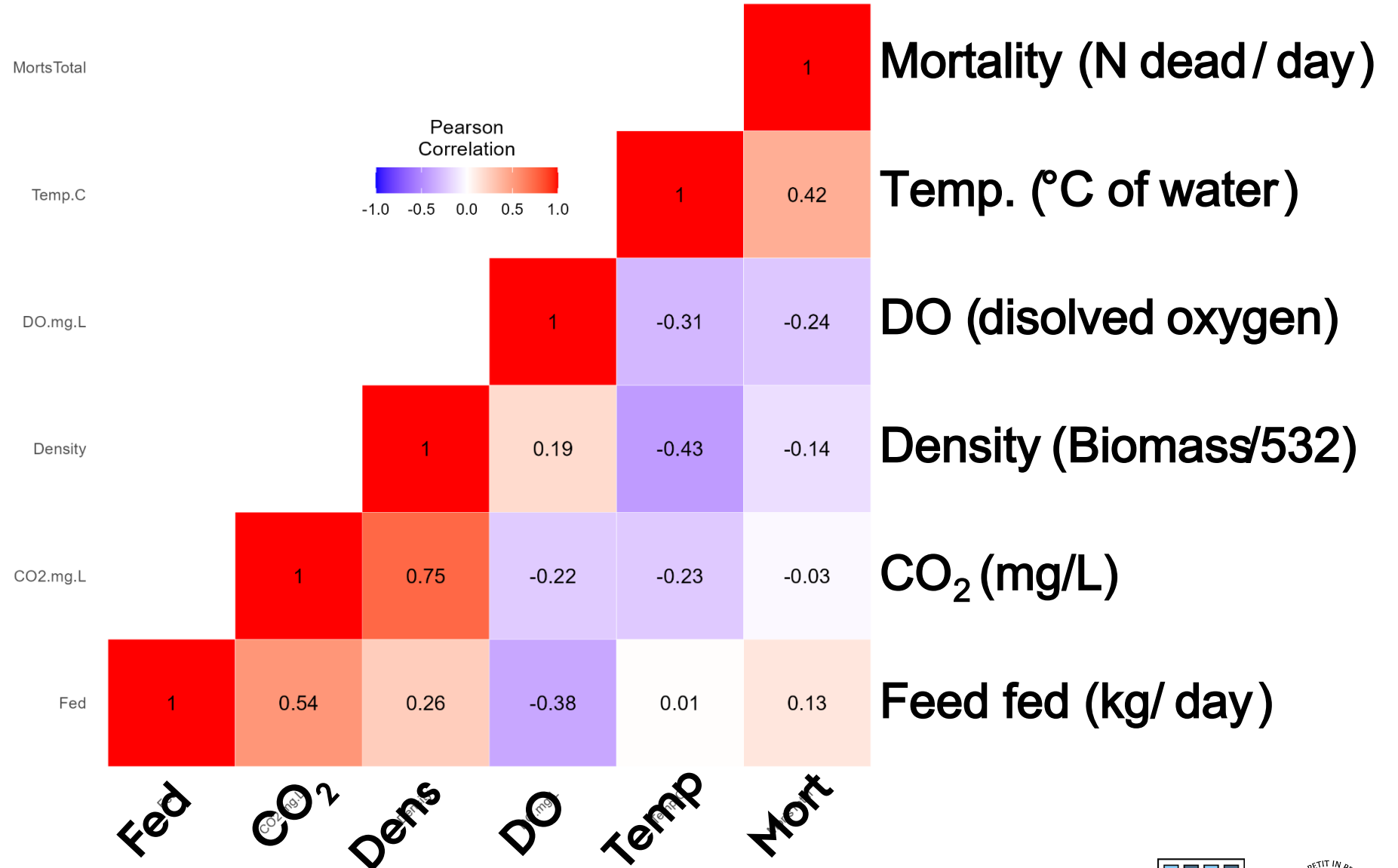
Aggregated and daily averages in Tank 1

Note: sensors are placed in subtank B



CORRELATION HEATMAP TANK 1 & 2 COMBINED

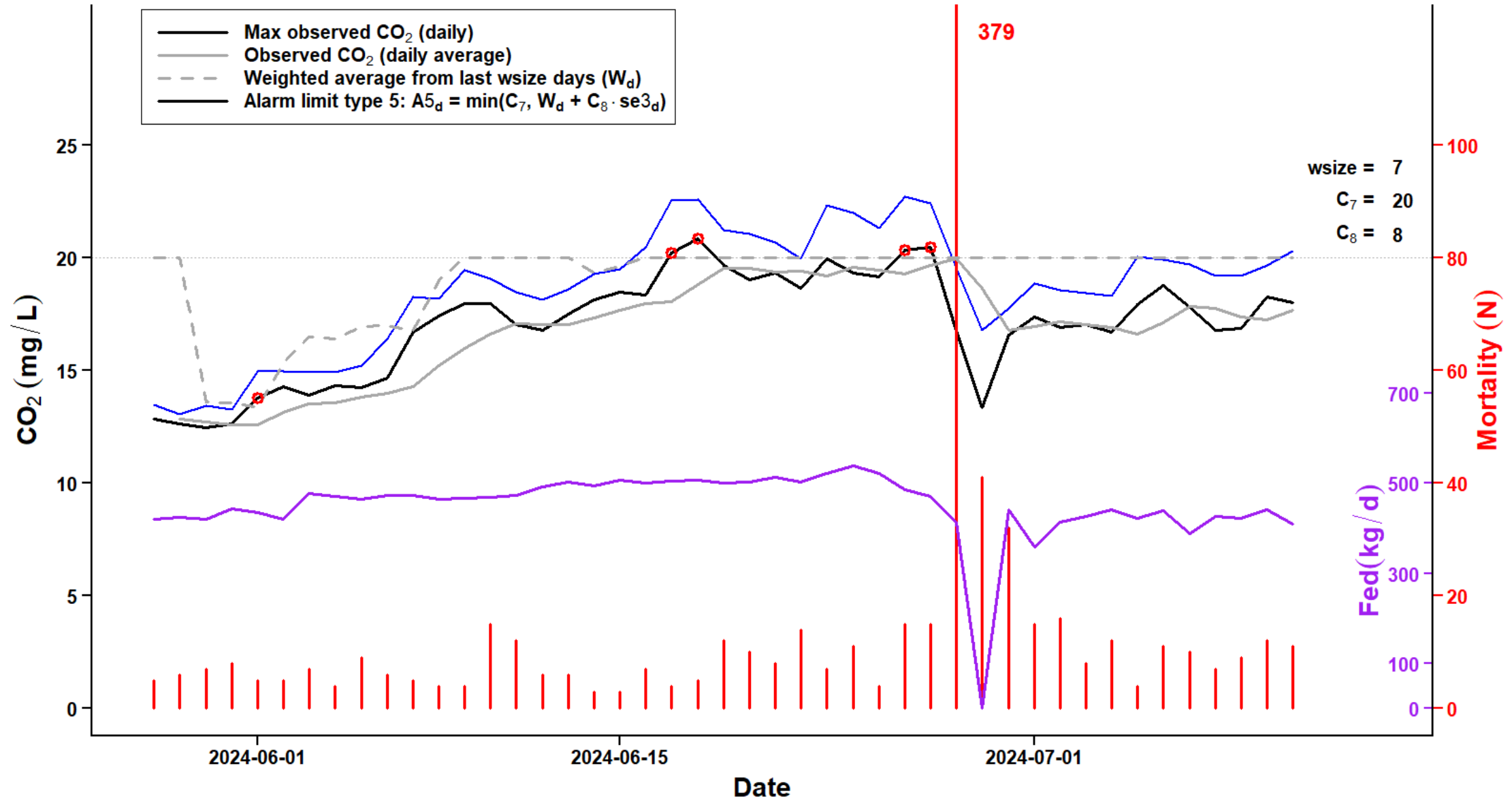
Omitting days
where Fed=0



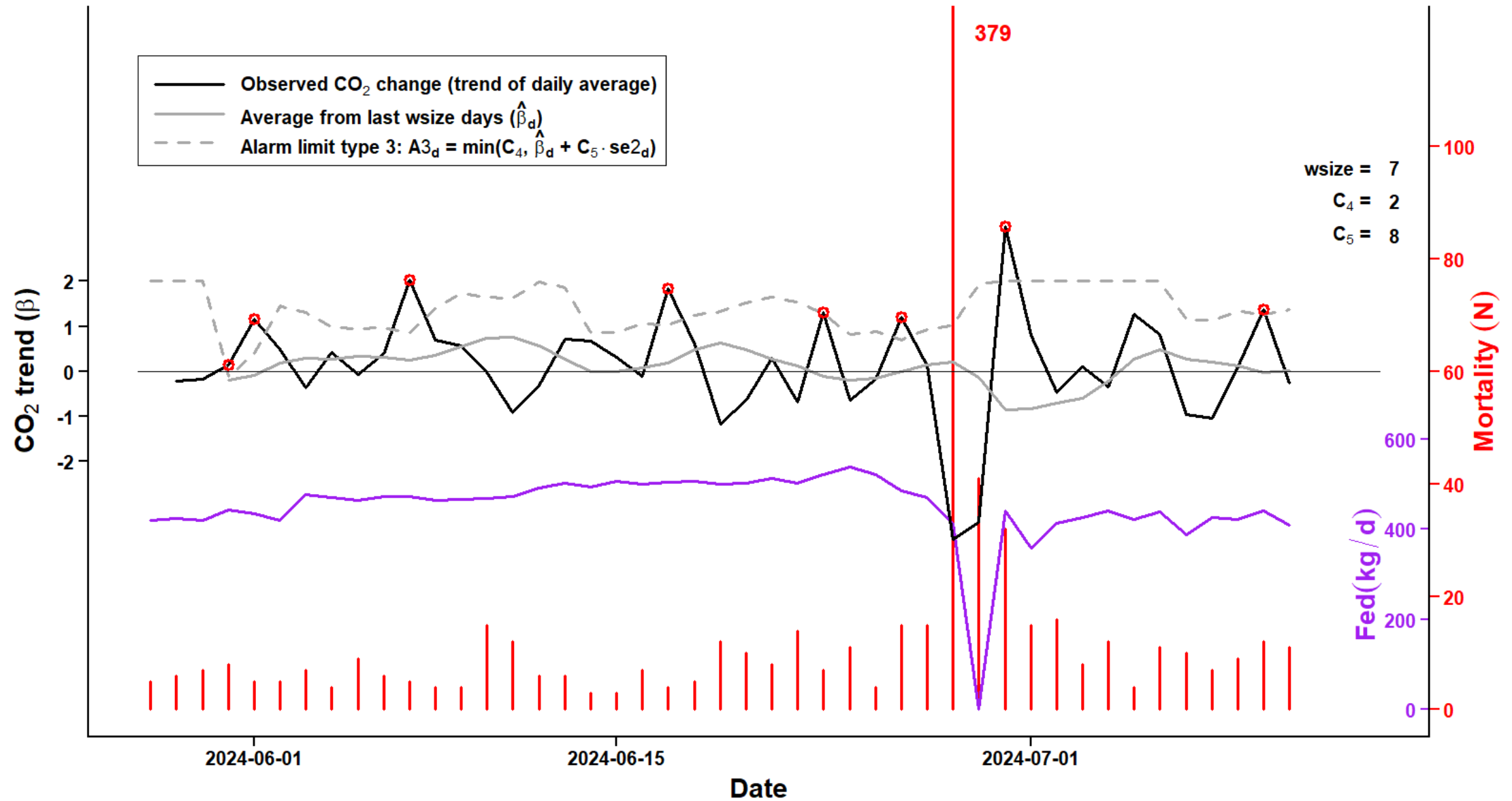
PFF TO CONTROL MORTALITY

- **Using mortality rates?**
 - Counting is done consistently across farms, and it is
 - not based on underlying functions or changed occasionally on basis of unclear reasoning.
- **Follow CO₂ by some kind of control chart to issue alarms?**
 - Although CO₂ and mortality were not correlated, we might still
 - like to know if it is getting high / above some threshold
- **Prediction using both sensor data and mortality counts**
 - ... and perhaps other measurable things or decisions?
- **Automated actions** based on the above?
 - ... or maybe go for a stable pH level?

Pilot study - CO₂ level alarms in Tank 2



Pilot study - CO₂ trend alarms in Tank 2



- IntelliRAS is supported by the Nordic Research and Innovation Programme for Sustainable Aquaculture under NordForsk (grant no. 104876); <https://www.nordforsk.org>
- Study period: 1 March 2021 – 1 September 2024
- <https://www.vetinst.no/en/research-and-innovation/ongoing-research-projects/intelliras>



Thank you for your attention

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