

Importance of osmoregulatory capacity in gills, intestine and kidney before sea-water transfer

RESEARCH QUESTION:

To test the effect of timing and length of winter signal in freshwater and brackish water (RAS) on osmoregulatory capacity in gills intestine and kidney

DURATION: August 2022-January 2023

FISH SIZE TESTED:

- 160 grams (Group: 1. No winter signal and 2. Normal winter signal)
- 30 grams (Group: 1. No winter signal 2. Normal winter signal and 3. Late winter signal)
- 850 grams (Group: 1. No winter signal, 2. Normal winter signal, 3. Late winter signal and 4. Late and prolonged winter signal)

SALINITY TESTED: Freshwater and brackish water (12 ppt)

HIGHLIGHTS:

Photoperiodic protocols:

- No winter, NW (Group 1; no response): No smolt related changes in Nka enzyme activity levels were observed in the three organs. Desmoltification was observed between 720 and 1836 degree days (dd) in all organs.
- Early winter signal (Group 2; strong response): Significant increase in Nka enzyme activity was observed, with peak activity levels found at 350 dd for gills while intestine and kidney attained peak enzyme activity levels at 720 dd. De-smoltification was observed between 720 and 1836 dd in intestine and kidney, but in gills this occurred between 350 dd and 720 dd (remains high in BW).
- Late winter signal (Group 3; strong response). Peak Nka enzyme activity levels were found at 350 dd for all tissues, indicating a more synchronized smoltification compared to the Normal Winter (Group 2). Desmoltification was observed between 350 dd and 1430 dd in all tissues.
- Late long winter signal (Group 4; weak response). The spring signal (24 h light)

appears have no effect on the Nka enzyme activity in gills and kidney while an increase was observed in the intestine. This indicate that the spring signal have a limited stimulatory effect in larger fish (>350 grams).

Salinity:

- Effect of brackish water (BW; no or weak response): Between 1430 dd and 1836 dd a clear reduction in Nka enzyme activity was observed in all groups and for all three tissues indicating loss of osmoregulatory capacity, despite being kept in 12 ppt BW. In addition, BW does not appear to stimulate the osmoregulatory capacity in any of the organs as no differences in activity levels could be observed during the experiment (except gills at 720 dd). Stronger salinity is therefore required to maintain seawater tolerance.

RECOMMENDATION:

- **SW transfer at 150 grams:** A traditional winter signal (Early winter protocol) should be used if the producer aims to transfer fish between



100-150 grams as all tissues have sufficient osmoregulatory capacity at 350 dd (150 grams). Transfer after 720 dd is possible when using 12 ppt BW as gill Nka enzyme activity are maintained in BW. It is not recommended to transfer after 720 dd, as desmoltification occurs in all tissues (see highlights in the figure). Continues light group should be avoided as no change occurs in the three organs and Nka activity levels are generally lower compared to fish receiving a winter signal (early winter or late winter).

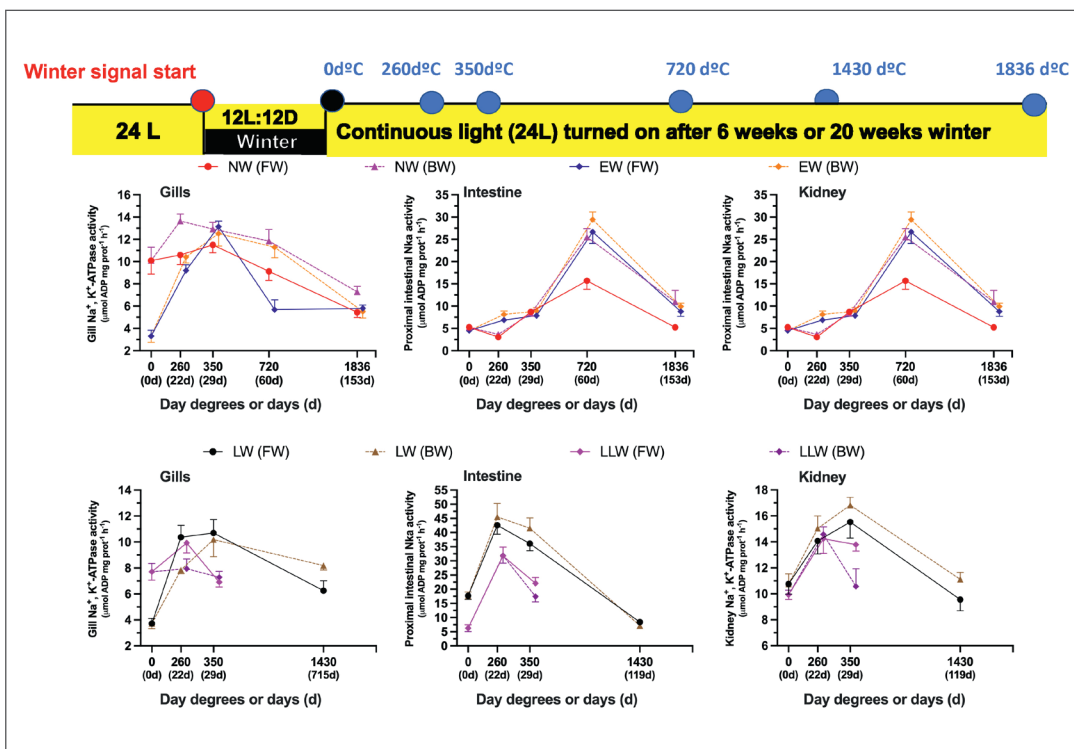
- **SW transfer at 350 grams:** A delayed winter signal (Late winter protocol) should be used if the aim is to extend the period in land based facilities and transfer fish at 350 grams. If this is not possible then the early winter protocol could be used together with 12 ppt salinity, although its recommend to use higher salinities protocol due to the apparent desmoltification in all organs between 720 and 1834 dd. The reduction in Nka enzyme activity likely occurs shortly after between 500 - 720 dd so it's not recommended to delay SW transfer after 720 dd using 12 ppt (+/- 1 week). Continues light (No winter protocol) is not recommended.

The factsheet is ready for implementation, but with the note that the testing has not been done for all industrial relevant conditions.

- **SW transfer at 820 grams:** No rearing protocols in applied in Benchmark II was able stimulate sufficient osmoregulatory capacity at time of SW transfer. Extending the winter signal for 18 weeks or trying to stimulate smolt development by photoperiod in 7-800 grams is not recommended as it they do not respond sufficiently to the photoperiod treatment. Use of higher salinity ranges (>20 ppt) should be considered to maintain high Nka enzyme activity levels high in all organs after smoltification to delay loss of osmoregulatory capacity.

READ MORE:

Same literature recommendation as the next fact sheet



Growth and maturation in seawater for the different protocols, ranged by final weight in November 2022.