PROJECT: BENCHMARK
SYSTEM: RAS
PARTNERS: Nofima, NORCE, University of Bergen, Pharmaq Analytiq, Pharmaq, Bremnes Seashore, Grieg Seafood, Cermaq Norway, Mowi
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CtrlAQUA

The effect of timing and length of a winter signal in RAS and size at transfer on post-smolt performance in seawater

RESEARCH QUESTION:

In Benchmark 1, the best performing group was the 100 g smolt transferred in August at the optimum smolt window, 360 daydegrees after the end of the winter signal. The groups that were transferred later at a bigger size had lower growth in seawater. The question was whether delaying and prolonging the winter signal in RAS could improve seawater performance of Atlantic salmon transferred to seawater at a larger size.

DURATION: 2021-2023

FISH SIZE TESTED: 50-3600 g

SALINITY TESTED: Fresh water and brackish water (12 ppt and 0 ppt)

HIGHLIGHTS:

- 24 h light improved growth in RAS whereas no positive effect of using brackish water was found.
- 24 h light in RAS led to reduced growth rate in seawater.
- Salinity in RAS did not affect growth in seawater.
- Fish transferred in September that were produced with early winter had the highest TGC (thermal growth coefficient) in seawater (3.3) and were largest at slaughter. Fish on 24 h light in RAS were slightly bigger at slaughter (3681 g) than fish given an early winter signal (3571 g).
- Mean bodyweight at slaughter for fish transferred in October and January were 3054 and 3058 g and TGCs were 3.0 and 2.4 respectively.
- Photoperiod and salinity in RAS did not significantly affect survival in seawater.
- The fish were infected with *Moritella viscosa* and Tenacibaculum which caused mortality due to winter ulcers from February until April.
- Fish transferred in September was less affected by winter ulcers and mortality until the end of April was 5% for this group. Fish transferred in October and January suffered mortalities of around 30% until late April.
- The fish was diagnosed with HSMB in July and delousing in July and September resulted in 15-20% mortality that was not related to size at transfer to sea.
- A 6-week winter signal in RAS and transfer at 850 g increased male maturation in seawater.

RECOMMENDATION:

- These are preliminary data as not all results are processed.
- It is recommended to transfer fish at a smaller size earlier in the fall if there is risk of outbreak of winter ulcers. Fish transferred in September at the smallest size had the best growth performance, survival and final bodyweight. They had higher resistance against winter ulcers, which was the main cause of mortality in seawater.
- A winter signal in RAS improves growth performance in seawater but reduce growth rate in RAS and may also induce maturation in males if the fish are kept in freshwater RAS up to around 800 g before transfer to seawater. Thus, a winter signal should be used with caution if the smolts are to be transferred to sea at a large size.
- The better performance of fish transferred earlier in the fall at a smaller size compared to fish transferred later in the fall at higher bodyweight is in line with the results from the Benchmark I trial, where fish transferred to sea in August and October performed far better than fish transferred in December. Thus, it seems that transfer of large fish in late fall is not a good strategy for optimal seawater performance.

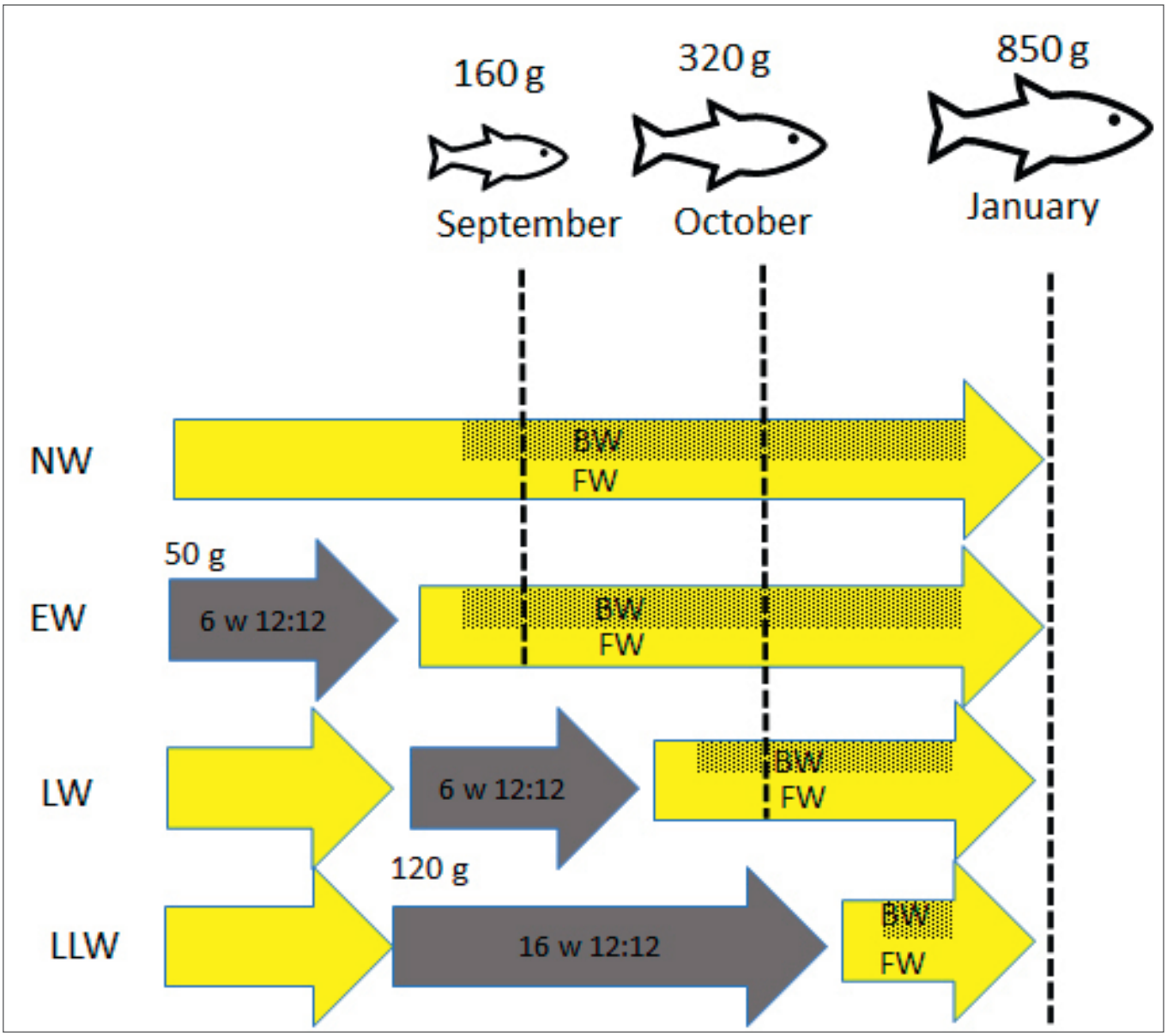
The factsheet is ready for implementation, but with the note that the testing has not been done for all industrial relevant conditions.

Protocol in RAS	Transfer time	Weight at transfer (g)	Final weight (g)	TGC in seawater	Maturation (% of dead males)
NW-BW	13th of Sept	185	3699 ****	3,2 ****	0 ****
NW-FW	13th of Sept	190	3663 ****	3,2 ****	0 ****
EW-FW	13th of Sept	151	3600 ****	3,3 ****	0 ****
EW-BW	13th of Sept	146	3546 ****	3,3 ****	0 ****
LW-BW	24th of Jan	901	3231 ***	2,4 *	7 ***
LW-FW	29th of Oct	341	3212 ***	3,3 ****	5 ****
EW-FW	24th of Jan	840	3110 **	2,4 *	23 *
NW-FW	29th of Oct	361	3108 **	2,9 ***	2 ****
LW-FW	24th of Jan	900	3102 **	2,3 *	26 *
LW-BW	29th of Oct	319	3091 **	3,0 ***	2 ****
LLW-BW	24th of Jan	725	3052 **	2,6 **	2 ****
EW-BW	24th of Jan	892	3037 **	2,3 *	21 *
NW-BW	24th of Jan	937	3000 *	2,2 *	3 ****
NW-BW	29th of Oct	351	2990 *	2,8 ***	7 ***
NW-FW	24th of Jan	920	2982 *	2,2 *	8 ***
EW-BW	29th of Oct	270	2963 *	3,1 ****	0 ****
EW-FW	29th of Oct	280	2963 *	3,0 ***	8 ***
LLW-FW	24th of Jan	730	2954 *	2,5 **	11 **

NW = No winter
EW= Early winter
LW= Late winter
LLW = Late long winter

	weight	TGC	maturation
****	3400-	3.1-3.3	0-5%
***	3200-3300	2.8-3.0	5-10%
**	3100-3000	2.5-2.7	10-15%
*	2900-3000	2.2-2.4	15-26%

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



Photoperiods in RAS and mean bodyweight at transfer to seawater pens at Gifas. The fish were exposed to 4 photoperiods in RAS, continuous 24 h light (NW), an early winter signal (EW, 6 weeks 12 h L:D from 50 g), a late 6-weeks winter signal (LW, from 120 g) or a long winter signal (LLW, 16 weeks from 120 g). All photoperiod treatments were replicated in freshwater (FW) and in brackish water RAS (12 ppt) until seawater transfer at in September, October and January. Seawater survival and growth performance was compared in the different treatments until slaughter in November 2022.