Costs and benefits of farming fish with selected behavioural and physiological traits

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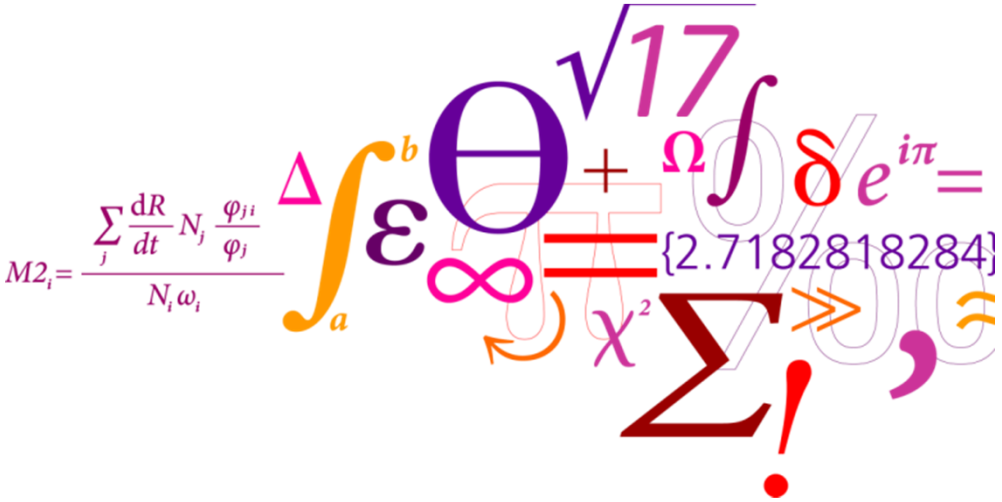

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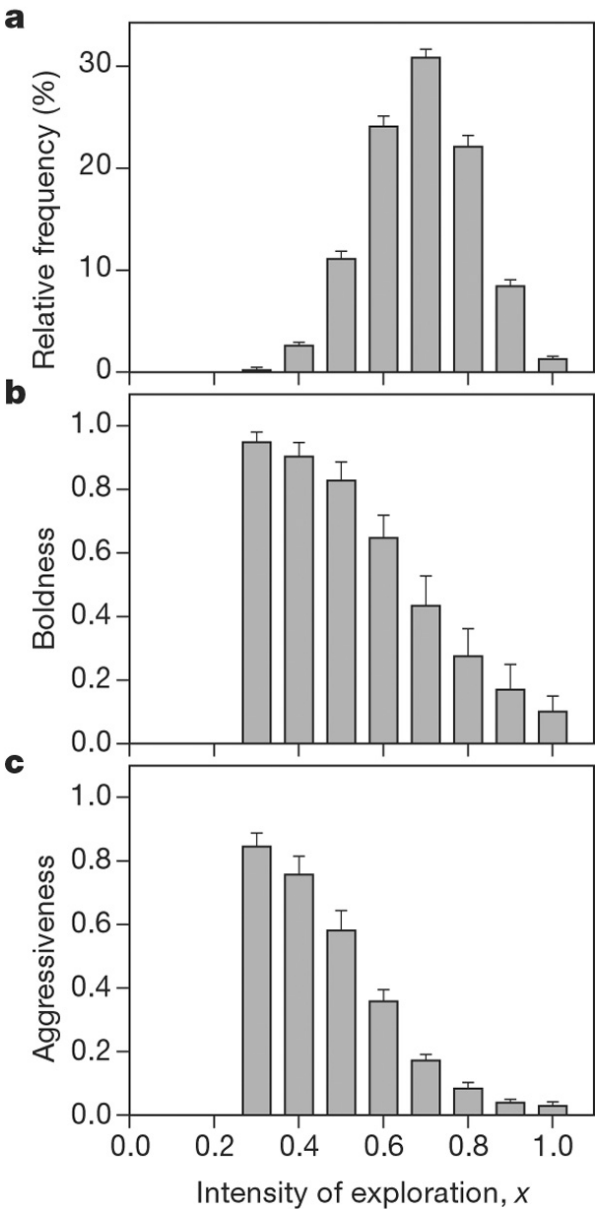
Hatching, emergence and personalities…

… a tool to select for fish with robust characteristics, good feed utilization, high stress resistance, high disease resistance?

	Predator present initially					
	Exp 1			Exp 2		
	N initial	N end	% survival	N initial	N end	% survival
I	39	0	0.0	39	5	12.8
II	98	19	19.4	98	66	67.3
III	62	20	32.3	63	51	80.8

	Predator introduced after emergence					
	Exp 1			Exp 2		
	N initial	N end	% survival	N initial	N end	% survival
I	39	30	76.9	25	8	32.0
II	88	45	51.1	98	12	12.2
III	51	15	29.4	62	5	8.1

Data from Brännäs (1995)



Wolf et al. (2007)

Q: If emergence time from gravel nests / redds correspond to or indicate, that individuals possess particular behavioural or physiological traits, could selective on-growing of certain fractions be more efficient in terms of feed utilization and lower mortalities?

Answering that requires an assessment of the behavioural and physiological characteristics of different emerging fractions, and testing their suitability in production.

Fish

3300 fertilized all-female eggs were obtained from Seven Springs Hatchery in Ireland and incubated in trays. Hatching occurred after 365 degree days.

Swim-up began 1 week later. A total of 3050 larvae were recovered according to their time of emergence in 20% fractions.

The early, middle and late emerging fractions were retained and reared in triplicate tank systems on commercial diets.

Experiments were performed when fish had reached a mass of ~30-70 grams, corresponding to insertion time in a commercial trout farm.

Screening

Production

Behaviour

Dropping an object into their arena and leaving it hanging (startle response and novel object): Fish seek shelter and measures are time to reappear, time to emerge, time spent exposed, approach or proximity to novel object.

Respiratory physio

Chase protocol: Standard metabolic rates, oxygen debt, maximum oxygen uptake rates, recovery times

Stress physio

Resting cortisol levels followed by low water stress challenge: Magnitude of the cortisol response and glucose mobilisation

Starvation and growth

Weight loss in individuals subjected to starvation for 10 days, weight gain following ad lib feeding for 7 days.

Weight loss under co- habituation with other fractions, competitive advantages under a restrictive feeding regime

Screening

Behaviour

Respiratory physio

Stress physio

Production

Starvation and growth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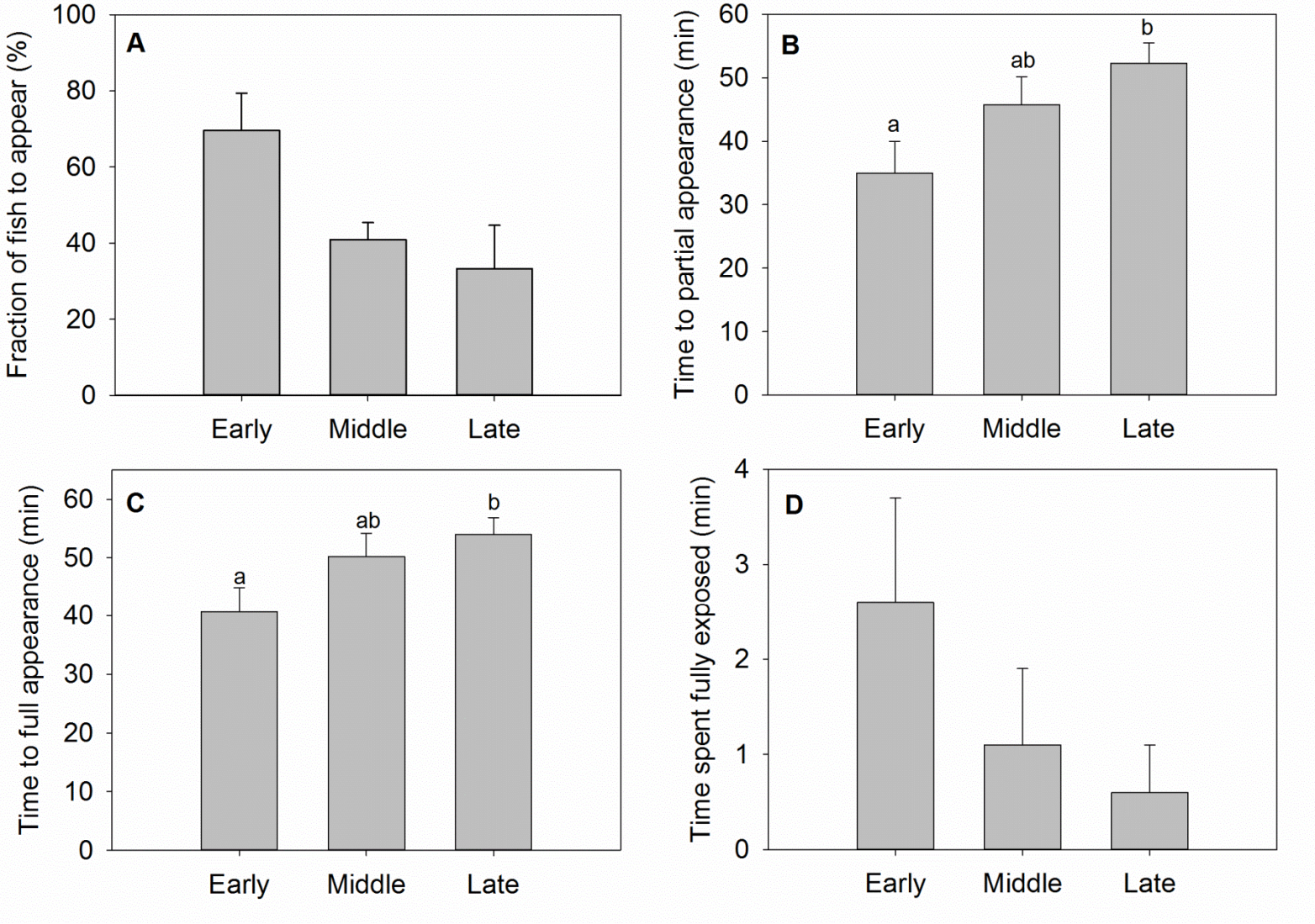

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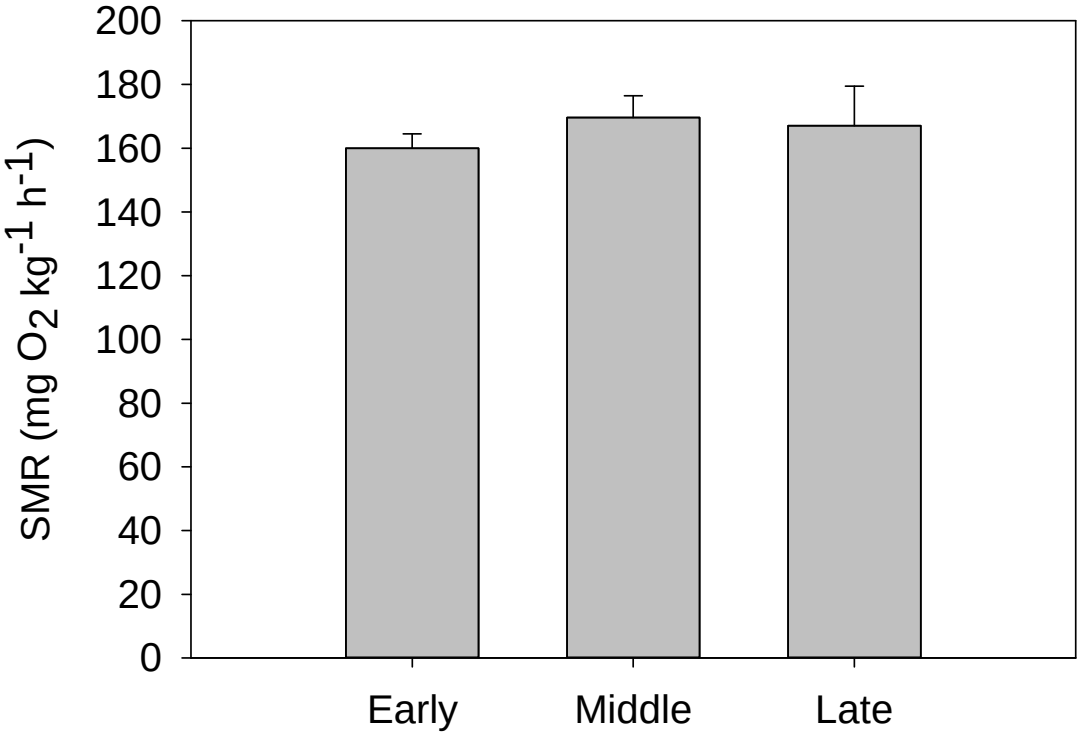

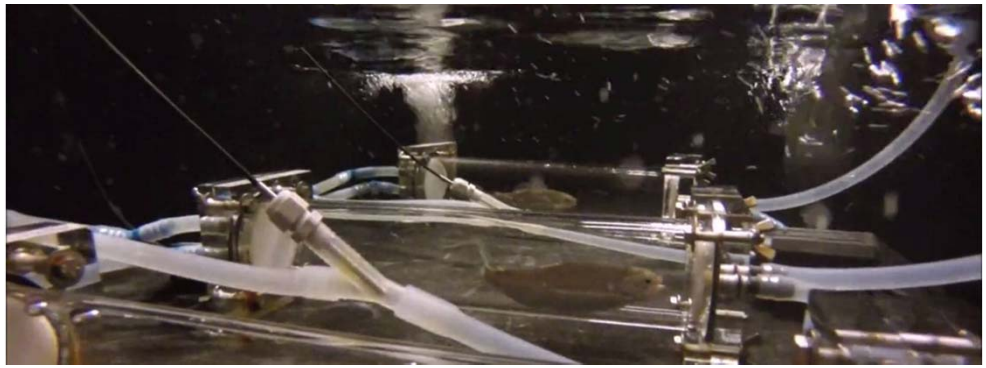

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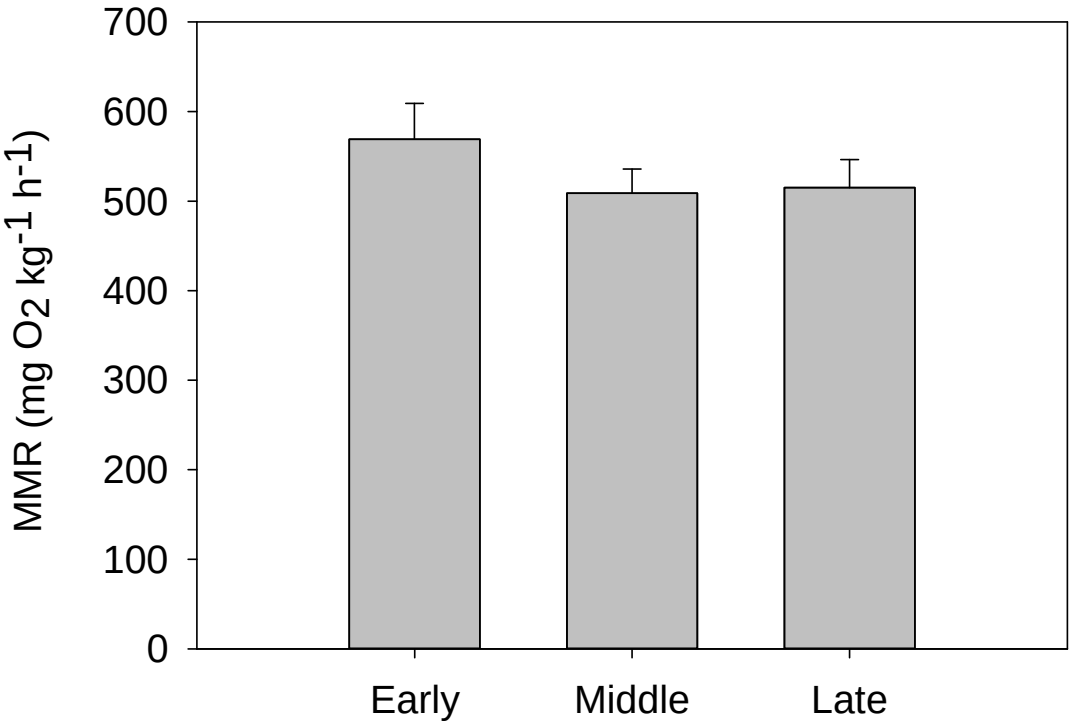

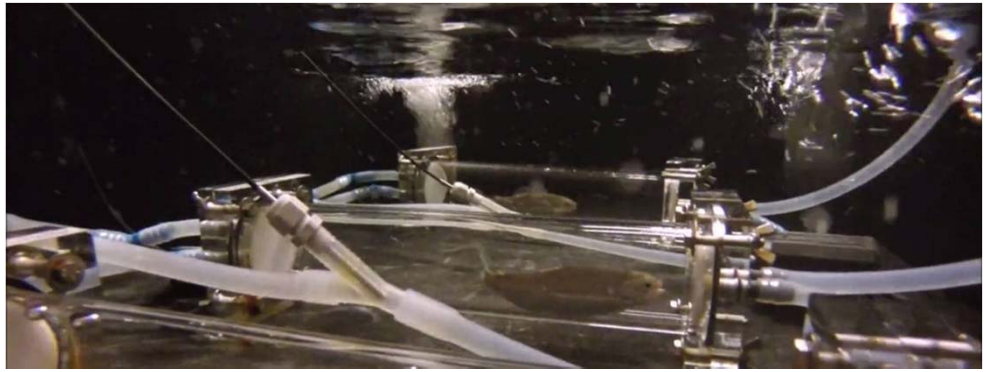

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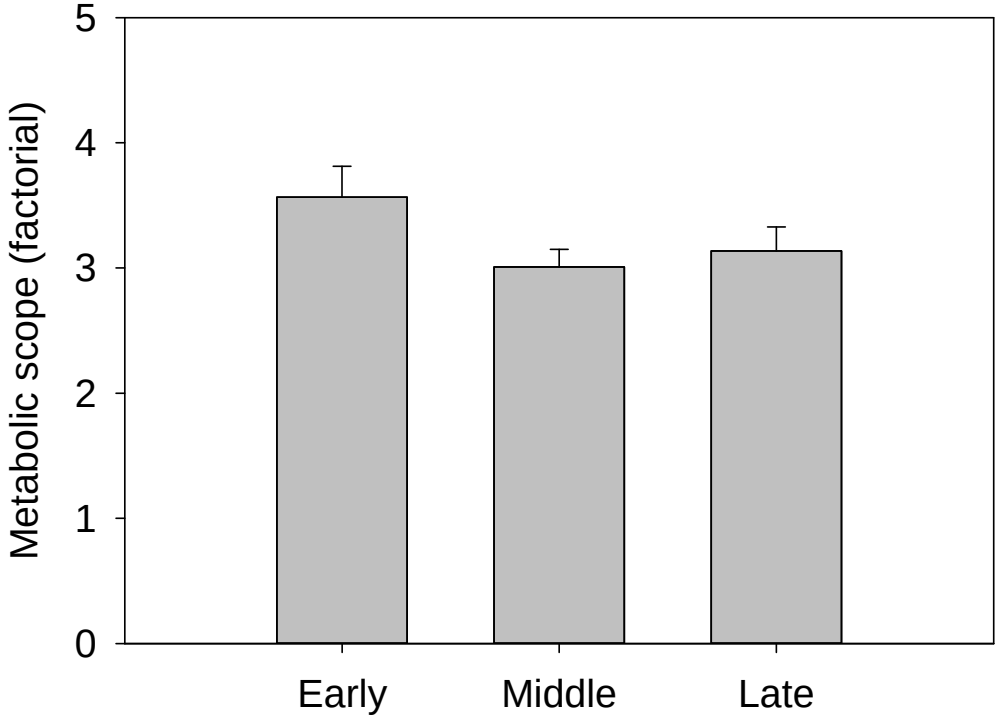

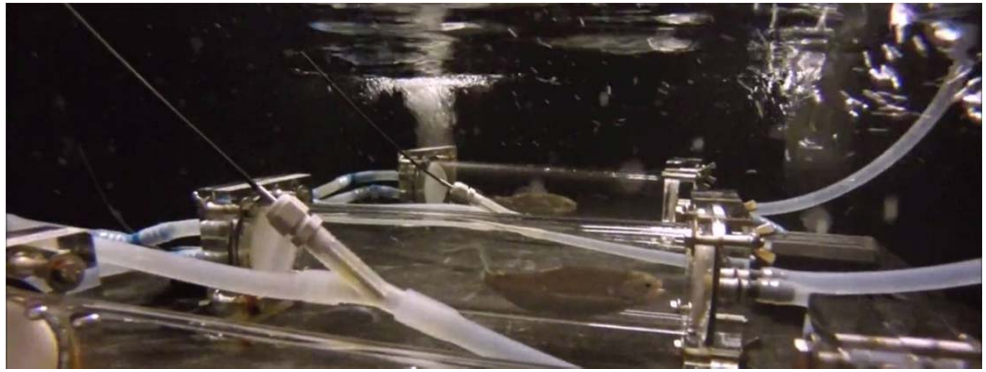

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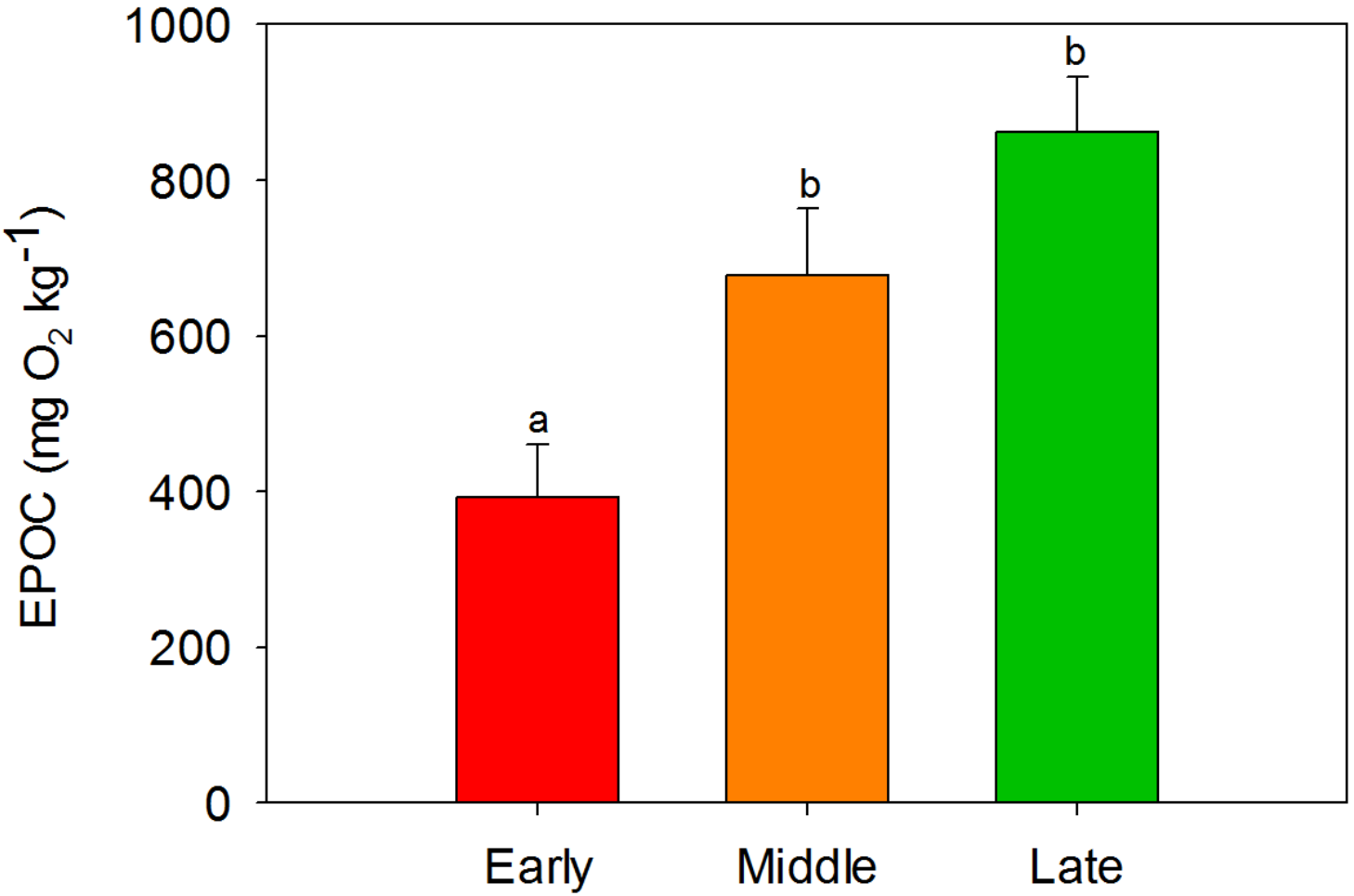

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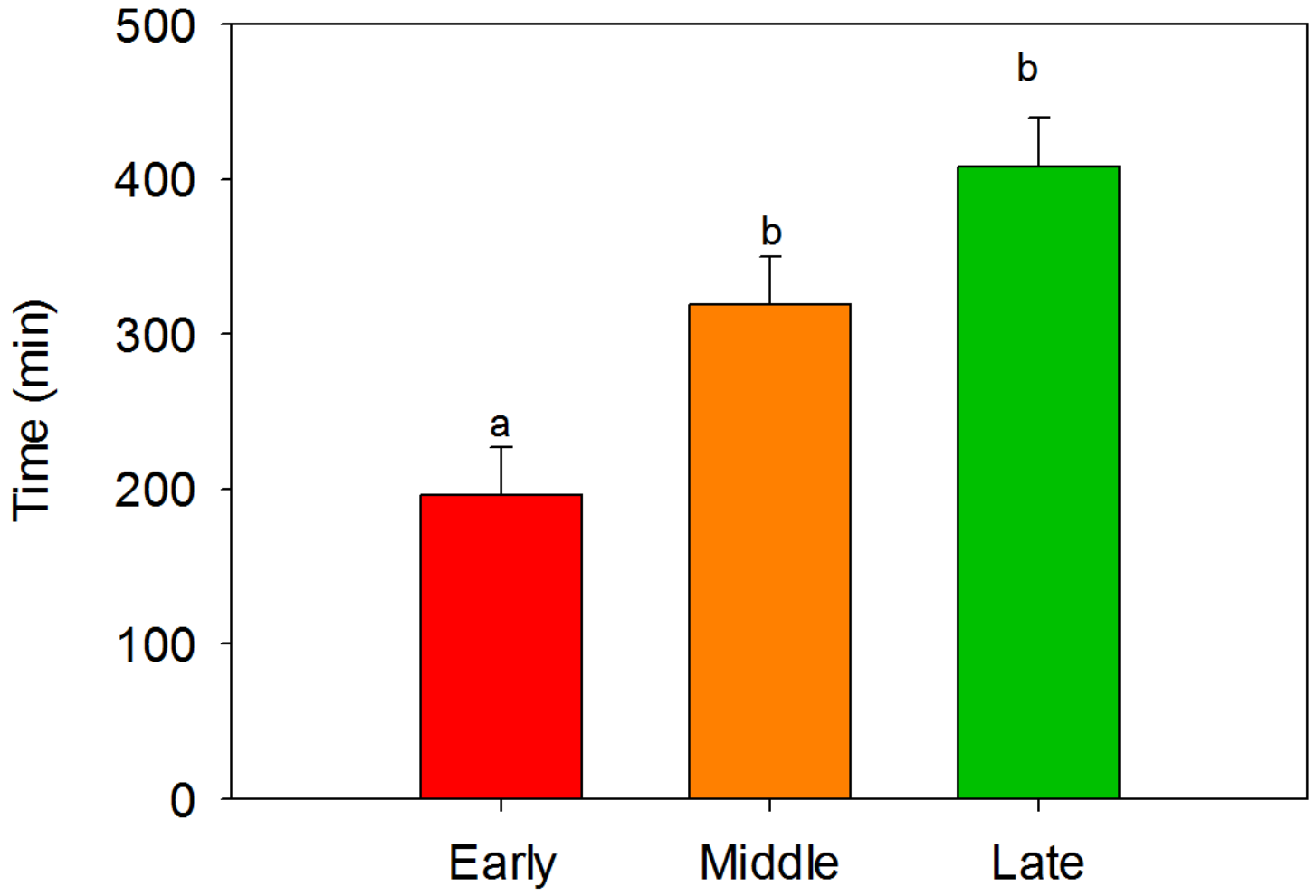

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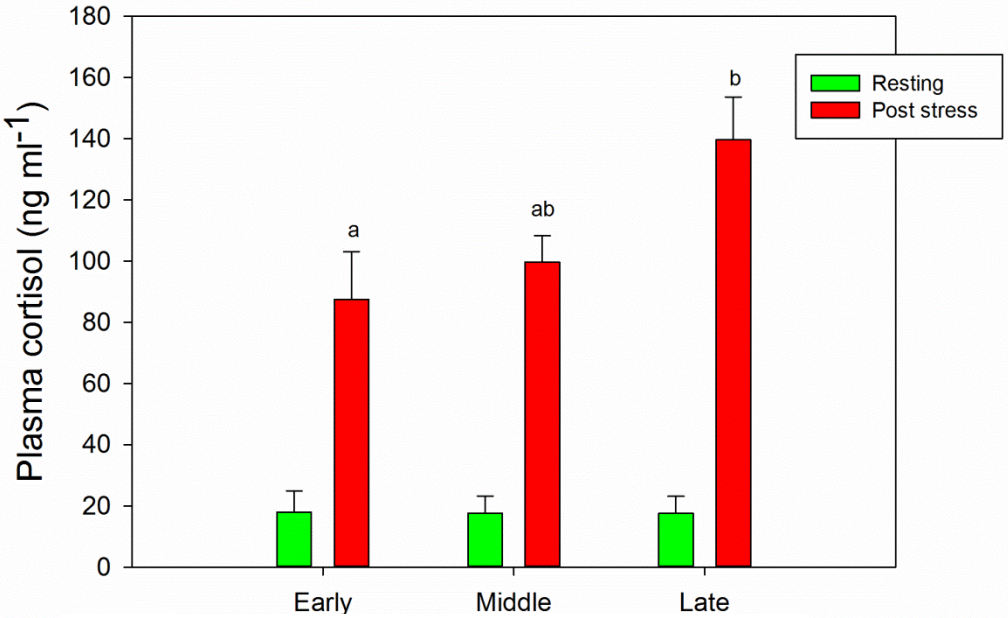

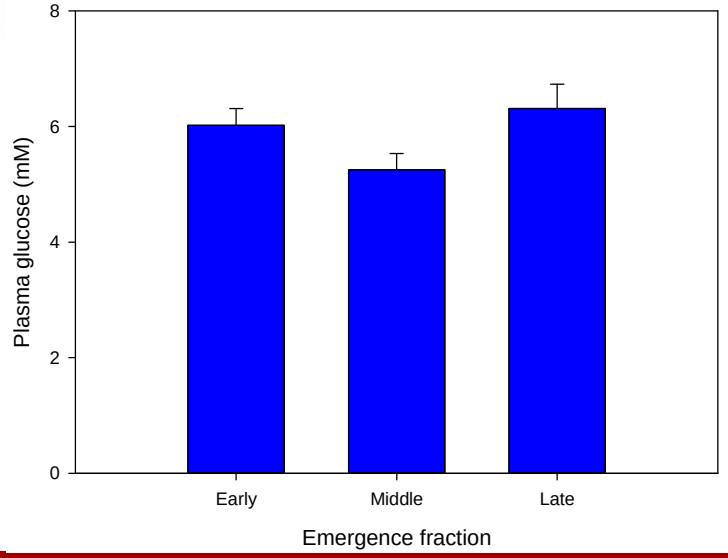

Individual experiments

10 randomly selected fish from each emergence fraction were housed individually in 30 liter aquarium sections in a RAS system thermostatted at 15°C.

Fish were fasted for 10 days, re-weighed and fed ad libitum in a single daily feeding event lasting 1 hour. At the end of feeding, all sections were vacuumed to remove any feed waste. After 7 days, fish were re-weighed.

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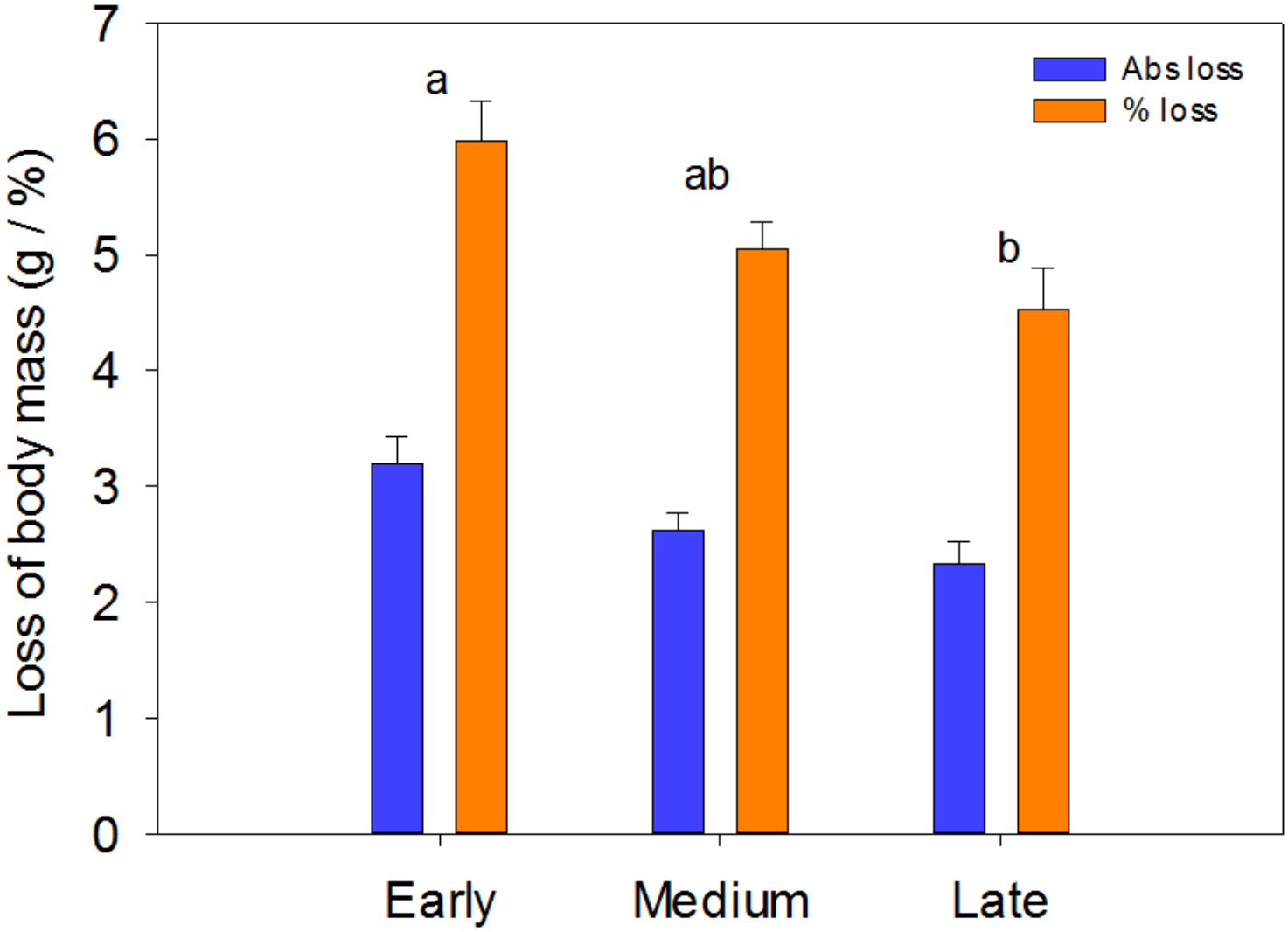

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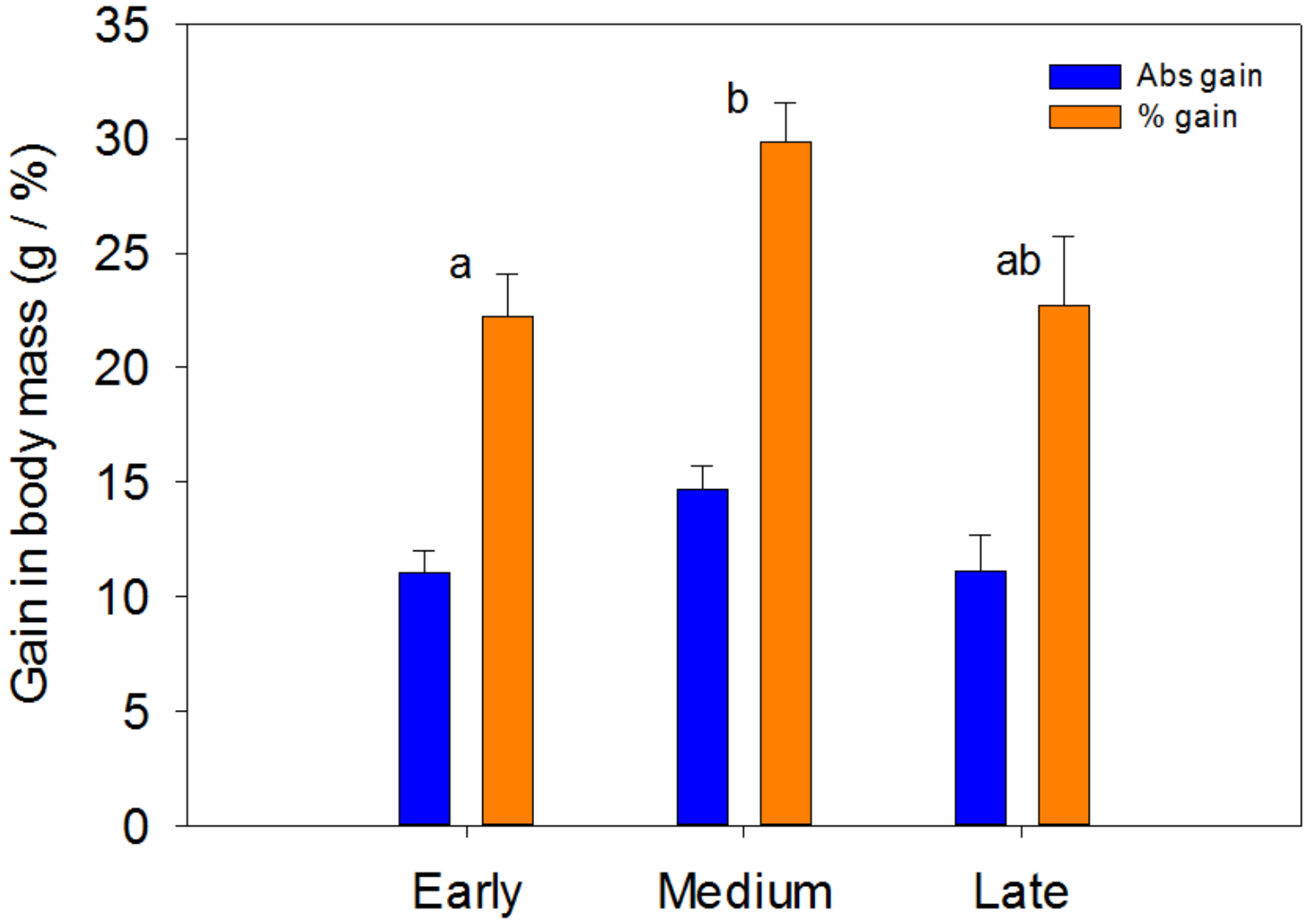

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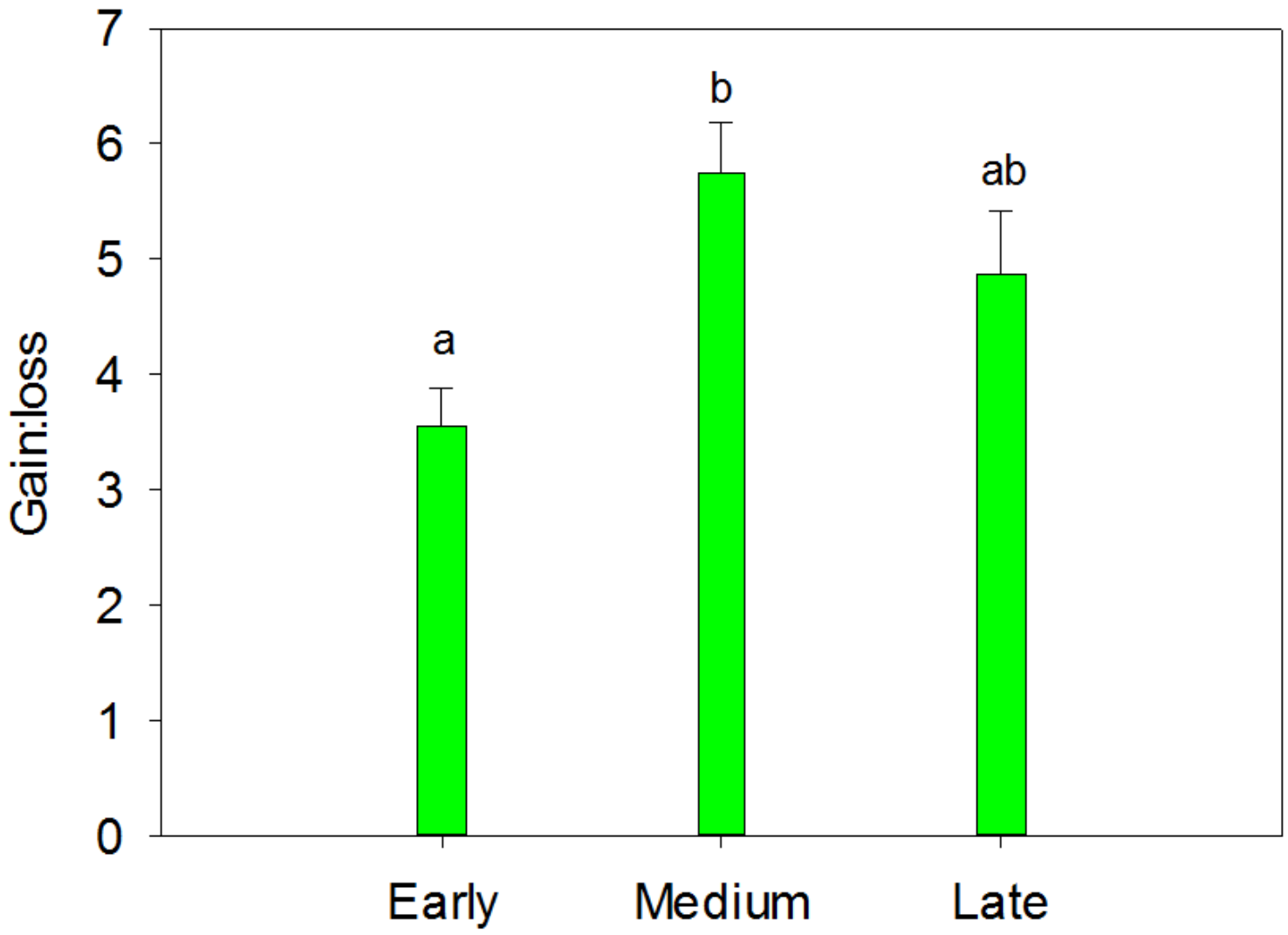

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Group experiments

75 randomly selected fish from each emergence fraction were pit-tagged and allowed to recover for 2 weeks. 75 fish were co-habituated (25 from each fraction) in triplicate 400 l tanks supplied by water from a RAS system thermostatted at 15°C.

Initial masses of individual fish were recorded, fish were then fasted for 10 days, re-weighed and fed a restrictive diet of 1% BM using mechanical belt feeders over 8 hours. After 7 days, fish were re-weighed.

	BM_{INIT}	BM_{FAST}	BM_{REFED}	$Loss_{ABS}$	$Gain_{ABS}$	Loss:Gain	$Loss_{REL}$	$Gain_{REL}$
	g	g	g	g	g		%	%
Early	67.6 ± 0.6	63.9 ± 0.6	72.3 ± 0.4	3.8 ± 0.1	8.4 ± 0.3^{a}	2.6 ± 0.2^{a}	5.6 ± 0.0	13.5 ± 0.5^{a}
Middle	68.2 ± 1.0	65.8 ± 2.1	75.3 ± 1.3	3.5 ± 0.2	10.9 ± 0.5^{b}	3.7 ± 0.1^{b}	5.1 ± 0.4	17.3 ± 0.9^{b}
Late	64.8 ± 1.5	62.2 ± 1.7	70.9 ± 1.5	3.4 ± 0.2	9.2 ± 0.5^{ab}	3.2 ± 0.3^{ab}	5.3 ± 0.2	15.1 ± 0.7^{ab}

Conclusions

Behavioural and physiological results demonstrate that different emergence fractions differ in certain characteristics while they do not in others;

Early emerging fractions are more bold, they display more exploratory behaviour and recover faster from startling compared to intermediate and late emerging fish.

There were no differences in SMR, MMR or the metabolic scope of different emergence fractions, however, early emerging fractions had a smaller oxygen debt following chasing, and repaid it quicker.

Early emerging fractions had a smaller cortisol response following a low water level challenge, but mobilisation of glycogen stores did not differ between fractions.

Conclusions

Early emerging fractions had a higher rate of weight loss in the face of starvation, probably linked to higher routine activity levels.

The intermediate group was most starvation tolerant, and gained weight faster during refeeding.

Co-habituation of different emerging fractions did not reveal a competitive advantage of early emerging fish under a restrictive feeding regime – again, the intermediate group once again outperformed.

Overall, the intermediate group appears to have the best overall characteristics for production.

Thank you for your attention!