Development of selection method of favorable juvenile fish by egg weight in masu salmon (*Oncorhynchus masou*)

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What kind of juvenile is favorable for discharging ?

The juvenile fish with favorable character of discharging selected by method without genetic and hormonal treatments. They can be expected to decrease negative effect on wild population as reduce number of discharging.

Why high growth (metabolic) individual after discharging is favorable for discharge ?

The larger juveniles of salmonid show high social dominance, and gain many food resource than other individuals (Vøllestad and Quinn, 2003; Harwood et al., 2003). As a result, they show higher survival rate than smaller individual in natural stream (Quinn and Peterson, 1996), and can develop an advantageous ability to adapt for seawater (Hoar, 1976).

Selection method

Fish source

Exp. 1 : 364 eyed eggs from 5 females.
(the third generation of Isatomae River (38° 42'N, 141° 31'E))
Exp. 2 : 551 eyed eggs from single females.
(the fourth generation of Naruse River (38° 22'N, 141° 10'E))

Selection standard

Exp. 1 : Lager group (≥ 0.090 g), smaller group (≤ 0.079 g)
Exp. 2 : Lager group (≥ 0.085 g), smaller group (≤ 0.079 g)

Rearing environment

Reared in separate tanks.

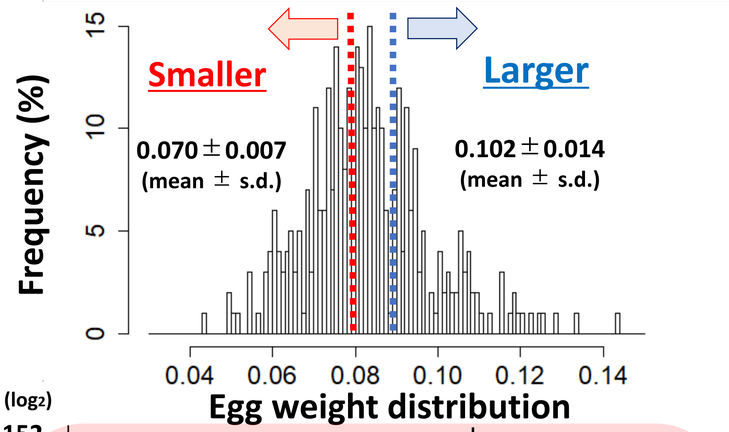
	Exp. 1	Exp. 2
Period	2018.Feb.~2019.Feb.	2019.Feb.~Oct.
Density(begin→final)	Larger：80→64, Smaller: 80→71	Larger：36→28, Smaller: 36→28
Photoperiod (L : D)	14 : 10 (July), 10 : 14 (December)	14 : 10 (July), 10 : 13 (October)
Templature (°C)	18 (July), 10 (December)	18 (July), 12 (October)
Feeding amount (of BW)	4% (2018.Feb.~Jun.) →2% (2018.Jul.~2019.Feb.)	4% (2019.Feb.~Jun.) →2% (2019.Jul.~Oct.)

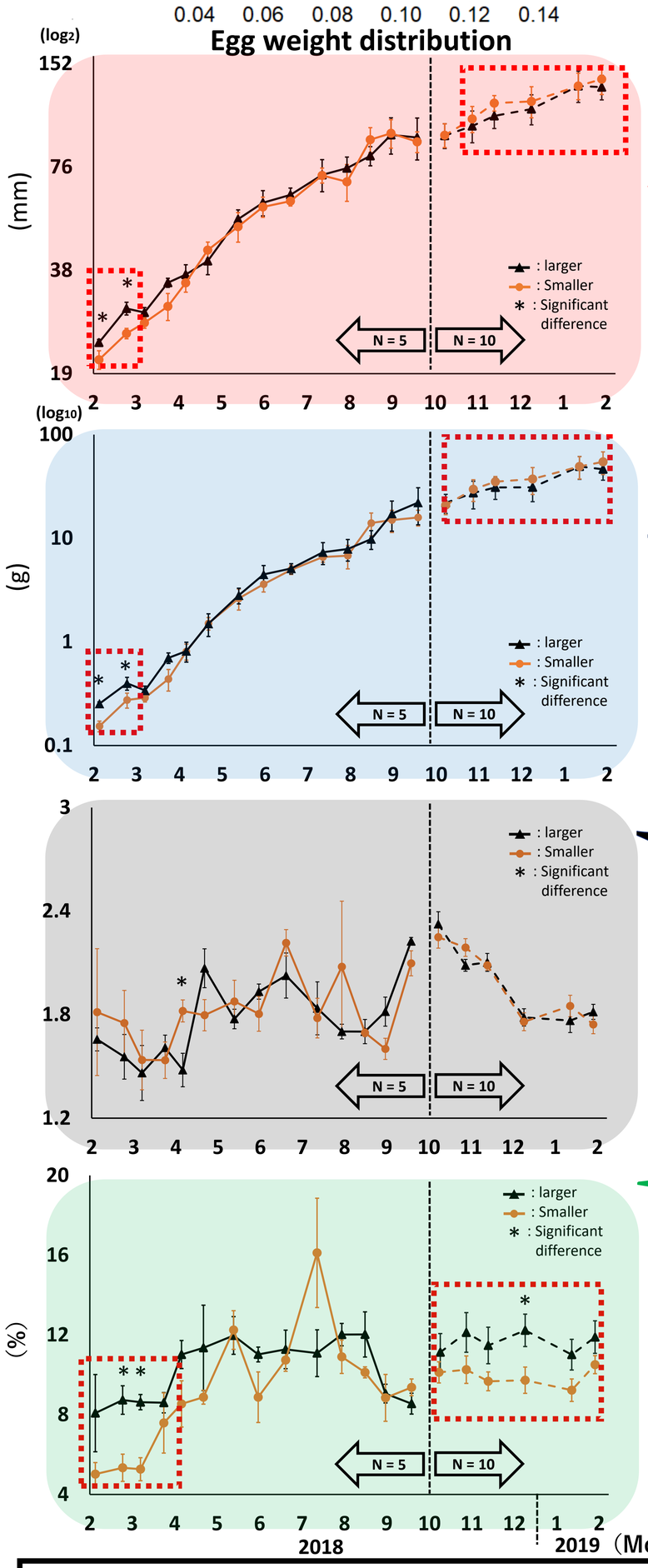
Sampling and statical method

We selected 5 (exp.1: 2018. Feb.~Oct.) or 10 (across all sampling except for 5 and 56 sampling) or 56 (exp. 2 : 2019.Oct.) juveniles from both groups, measured body weight (BW), and took picture of left or both sides. Moreover, we measured standard length (SL), body surface and parr mark area from the pictures by using "Image J"(Rasband, 1997-2012). Significance levels were less than 5% ($p < 0.05$).

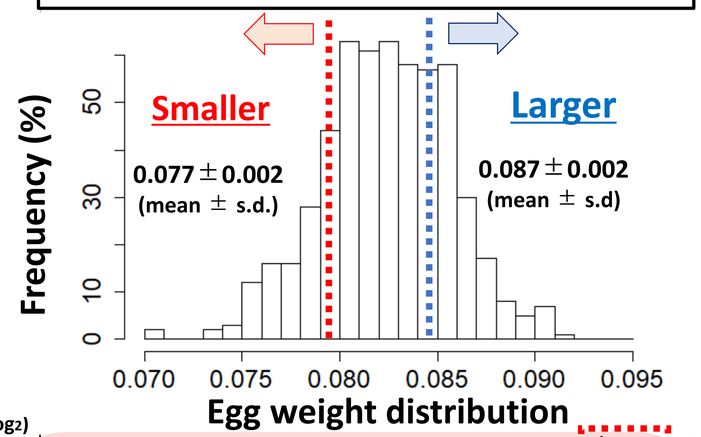
Items	Statistics
• SL • BW • Condition factor (CF) (BW/(SL)^3 ×100) • Parr mark index (PAI) (Total parr mark area/body surface area ×100)	Student's-*t* test

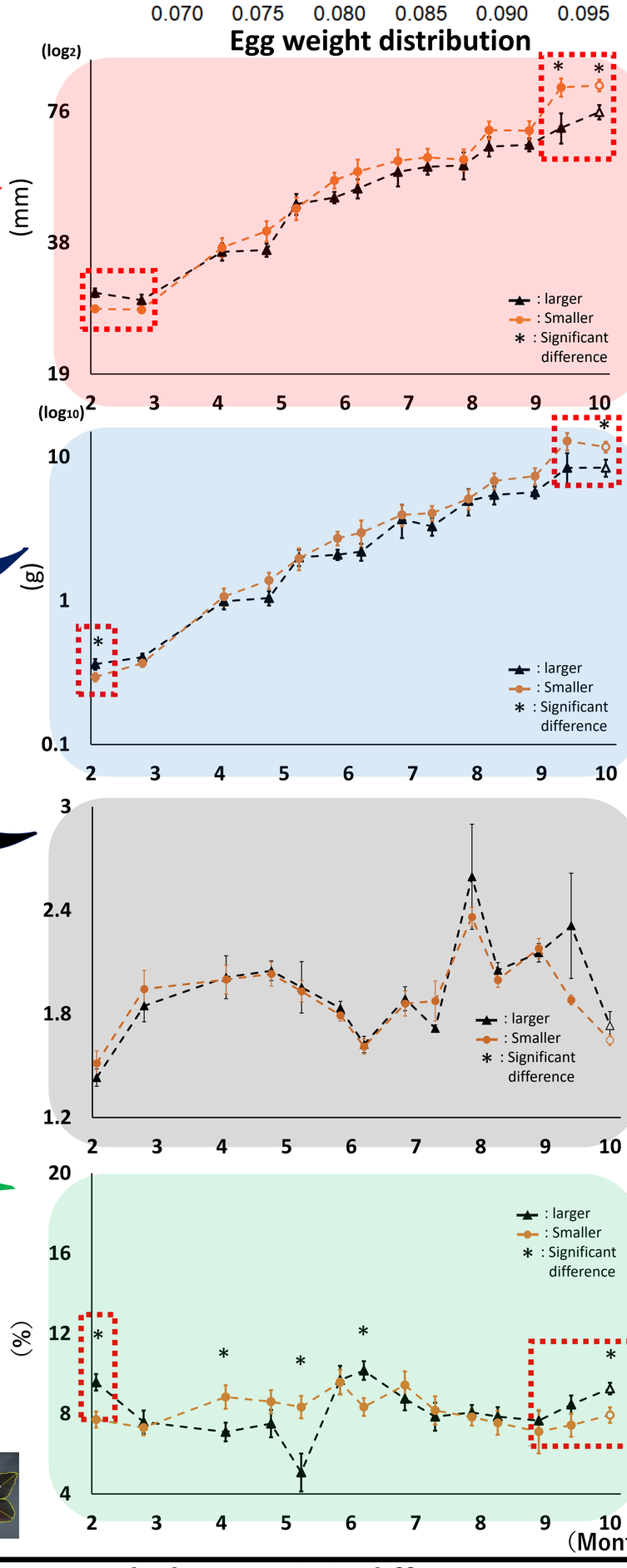
Multiple females (Exp. 1)





Single female (Exp. 2)





SL

・In early period (February of 0 age) of rearing term, larger egg groups tended to show higher values.

・In later period (after October) of rearing term, , smaller egg groups tended to show higher values.

BW

・In early phase (February of 0 age) of rearing term, larger egg groups tended to show higher values.

・In later time (after October) of rearing term, smaller egg groups tended to show higher values.

CF

・No significant difference was observed across all sampling.

PAI

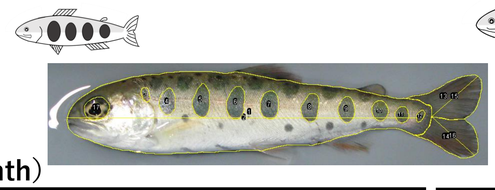
・In early (February of 0 age) and later (after October) period, larger egg groups tended to show higher values.

Summary

Smaller egg groups tended to showed larger body size in later period, and lower PAI in early and later period.

In later time…

Larger egg group



Smaller egg group

Discussion 1. The cause of growth difference between groups

・The salmonid fish of inhabit in lower latitude area showed smaller egg but showed higher metabolic rate (Tamate and Maekawa, 2000; Morita and Nagasawa, 2010; Seppänen et al., 2009; Morita et al., 2009; Morita et al., 2014) .

・The positive relation metabolic rate (egg size) and growth rate in masu salmon. (Yamamoto et al.,1988)

→ **Our results also showed that smaller egg group has a higher growth rate than larger egg group.**

Discussion 2. The cause of parr mark characteristic difference between groups

The juvenile of population with decreasing migration type is increased parr mark number than juvenile of usual population (Northcote and Hartman, 1988). Therefore, parr mark characteristic may relate migration behavior such as smoltification, however, the mainly role and meaning of parr mark characteristic are unknown still now.

→ **It is probable that exist relation between parr mark area and egg weight. However, the reason is unknown.**

Egg weight selection may select individuals with higher growth rate and smaller parr mark area as suitable for discharge.

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