

Physiological effects of RAS flow regime on steelhead *Oncorhynchus mykiss* and coho *O. kisutch*



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Introduction



- Use of RAS technology is being considered at NFHs due to reductions in water available for fish rearing and the need to control hatchery effluent.
- The three main areas that can impact fish performance and are different in RAS systems are water quality, routine fish handling practice, and the flow regime in self-cleaning tanks.
- Of these three areas, flow regime may have large impacts on fish physiology that can influence smolt quality and survival.

Objective

- To determine effects a RAS water flow regime has on the physiology of steelhead and coho but not to compare the two species.



Methods



- Steelhead stocked into each of six 10ft circular tanks; 27.5 gm average weight
- Coho stocked into each of six 10ft circular tanks; 6.2 gm average weight
- The 10 ft diameter tanks are 3 ft deep, therefore the volume is 236 cu ft (or 6.68 m³)
- Abernathy Creek water was used providing seasonal temperatures

Methods

- Three tanks set up to simulate recirculating tank flows; three tanks had a standard configuration
- The simulated recirculating tank flows: 45.2 gpm, 71% of the water flow went out the side drain, 29% of the water went down the center drain.
- The standard configuration was a spray bar that deliver approximately 9 gpm and all water went down the center drain.

RAS tank configuration for water flow



Side drain →



← Water inflow

Standard configuration



← Spray bar

Center drain with standpipe →



Methods

- Fish were raised for 5 months (steelhead);
10 months (coho)
- Data taken:
 1. weight, length, fin condition
 2. proximate composition of the fish
(protein, lipid, moisture, ash)
 3. gill Na^+ , K^+ -ATPase, plasma Na^+ , K^+ , Cl^-
 P^+ and lactic acid, glucose and
cholesterol

Methods



Growth, steelhead



Treatment	% Weight gain	Length mm	% Survival
RAS	185.9	195.6	90.5
Standard	178.2	192.8	95.2

Growth, coho



Treatment	% Weight gain	Length mm	% Survival
RAS	294.4	131.3	85.2
Standard	295.7	134.3	86.8

Fish proximate analysis, steelhead

<u>Midpoint</u>	%Protein	%Lipid	%Moisture	%Ash
RAS	16.5	6.7	73.6	2.4
Standard	16.4	6.7	73.8	2.4
<u>Terminal</u>	%Protein	%Lipid	%Moisture	%Ash
RAS	16.9	5.7	74.4	2.4
Standard	16.9	5.4	74.8	2.5

Fish proximate analysis, coho

<u>Midpoint</u>	%Protein	%Lipid	%Moisture	%Ash
RAS	15.2	7.3	74.9	2.6
Standard	15.3	7.1	75.0	2.5
<u>Terminal</u>	%Protein	%Lipid	%Moisture	%Ash
RAS	16.6	3.9	77.4	2.5
Standard	16.0	4.2	77.4	2.7

Fin condition

Fin index (%)	
<u>Steelhead</u>	
RAS	3.5
Standard	3.4
<u>Coho</u>	
RAS	10.9
Standard	11.0
Fin index=(fin lengthX100)/(fish total length)*	

*Kindschi 1987

Blood parameters, steelhead

	Glucose mmol/L	Cholesterol mg/dL	Lactose mg/dL
RAS	146.3	295.0	5.8
Standard	151.7	282.7	5.7

Average of 12 fish
from each tank



Blood parameters, coho

	Glucose mmol/L	Cholesterol mg/dL	Lactose mg/dL
RAS	110.0	257.3	6.4
Standard	108.3	263.7	7.3

Average of 12 fish
from each tank

Blood parameters, steelhead

	P mg/dL	Na mmo/L	K mmo/L	Cl mmo/L	
RAS	16.5	154.6	1.2b	141.7	P=0.007
Standard	17.0	154.6	2.1a	141.7	
<u>Midpoint</u>	ATPase umoles ADP/mg protein/hr				
RAS	2.0				
Standard	1.9				
<u>Terminal</u>					
RAS	4.2a				P=0.045
Standard	3.4b				

Average of 12 fish per tank;
20 fish average for the ATPase per tank

Blood parameters, coho

	P mg/dL	Na mmo/L	K mmo/L	Cl mmo/L	
RAS	13.0	150.7	7.1	120	
Standard	12.9	156.7	7.2	144	
<u>Midpoint</u>	ATPase umoles ADP/mg protein/hr				
RAS	1.3				
Standard	1.1				
<u>Terminal</u>					
RAS	3.0				
Standard	2.6				

Average of 12 fish per tank;
20 fish average for the ATPase per tank

Summary, steelhead



- Most parameters were not significantly different
- Na, K -ATPase was significantly higher in the RAS raised fish in the terminal sample; fish in both types of tanks had Na, K-ATPase increase from the midpoint of the study
- K was significantly lower in the RAS raised fish; this result may be related to the increased ATPase activity

Summary, coho

- No parameters were significantly different
- Although the Na, K -ATPase was slightly higher in the RAS raised fish in the terminal sample, the results weren't significant
- As with the steelhead, coho in both types of tanks had the Na, K-ATPase increase between the middle and end of the study



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