

EFFECTS OF FERTILIZATION RATES ON GROWTH PERFORMANCE OF RED TILAPIA AT DIFFERENT SALINITIES

Yang Yi and C. Kwei Lin

Aquaculture and Aquatic Resources Management
Asian Institute of Technology

James S. Diana

School of Natural Resources and Environment
University of Michigan
Ann Arbor, USA

INTRODUCTION

- Many tilapia species are euryhaline and can grow in saline water:
Oreochromis mossambicus, *O. niloticus*, *O. aureus*, *O. spilurus*, red tilapias
- Tilapia culture in saline water: intensive
- Interest in semi-intensive culture in brackishwater ponds: integrated with shrimp, monoculture
- Fertilization for semi-intensive culture in saline ponds: milk fish, marine shrimp, etc.
- Difference in chemical constituents between seawater and freshwater

Constituent		Sea water		River water	
		Concentration (mg/l)	Rank	Concentration (mg/l)	Rank
<i>Major ions^b</i>					
Chloride	(Cl ⁻)	19,340	1	8	5
Sodium	(Na ⁺)	10,770	2	6	6
Sulfate	(SO ₄ ²⁻)	2,712	3	11	4
Magnesium	(Mg ²⁺)	1,294	4	4	7
Calcium	(Ca ²⁺)	412	5	15	2
Potassium	(K ⁺)	399	6	2	8
Bicarbonate	(HCO ₃ ⁻)	140	7	58	1
Bromide	(Br ⁻)	65	8	-	-
Strontium	(Sr ⁺)	9	9	-	-
<i>Trace elements mg/l</i>					
Boron	(B)	4,500	1	10	15
Silicon	(Si)	(5,000)	2	13,100	3
Fluoride	(F)	1,400	3	100	12
Nitrogen	(N)	(250)	4	230	11
Phosphorus	(P)	(35)	5	20	13
Molybdenum	(Mo)	11	6	1	18
Zinc	(Zn)	5	7	20	14
Iron	(Fe)	3	8	670	9
Copper	(Cu)	3	9	7	17
Manganese	(Mn)	2	10	7	16
Nickel	(Ni)	2	11	0.3	19
Aluminum	(Al)	1	12	(400) ^b	10

Objectives

- To determine appropriate fertilization rates
- To observe effect of salinity on tilapia production in fertilized ponds

Experimental design and facility set-up

- Experiment venue: Asian Institute of Technology (AIT), Thailand,
- Time duration: 5 months
- Experiments design: RCB; 2x3 factorial; 3 replications
Fertilization rate (week): 28 kg N and 7 kg P ha⁻¹ ; and 14 kg N and 7 kg P ha⁻¹
Salinity (ppt): 10, 20, and 30 (dilute 150 ppt brine)
- Treatment: six combinations and a control with 28 kg N and 7 kg P ha⁻¹ in freshwater
- Culture facility: twenty-one 4 m³ (2x2.5 x0.8 m) cement tanks with 10-cm soil on the bottom.

Experimental inputs

- Fish: Sex-reversed all-male Thai red tilapia (20.2-23.7 g size); acclimated to respective salinity at 5-ppt increments over two days
- Stocking density: 25 fish/tank
- Fertilization: weekly, applied sodium bicarbonate at 250 kg/ha in the third week.
- Maintained stable salinity and water level by topping up with freshwater
- Continuous aeration with diffuser air stones

Measurements

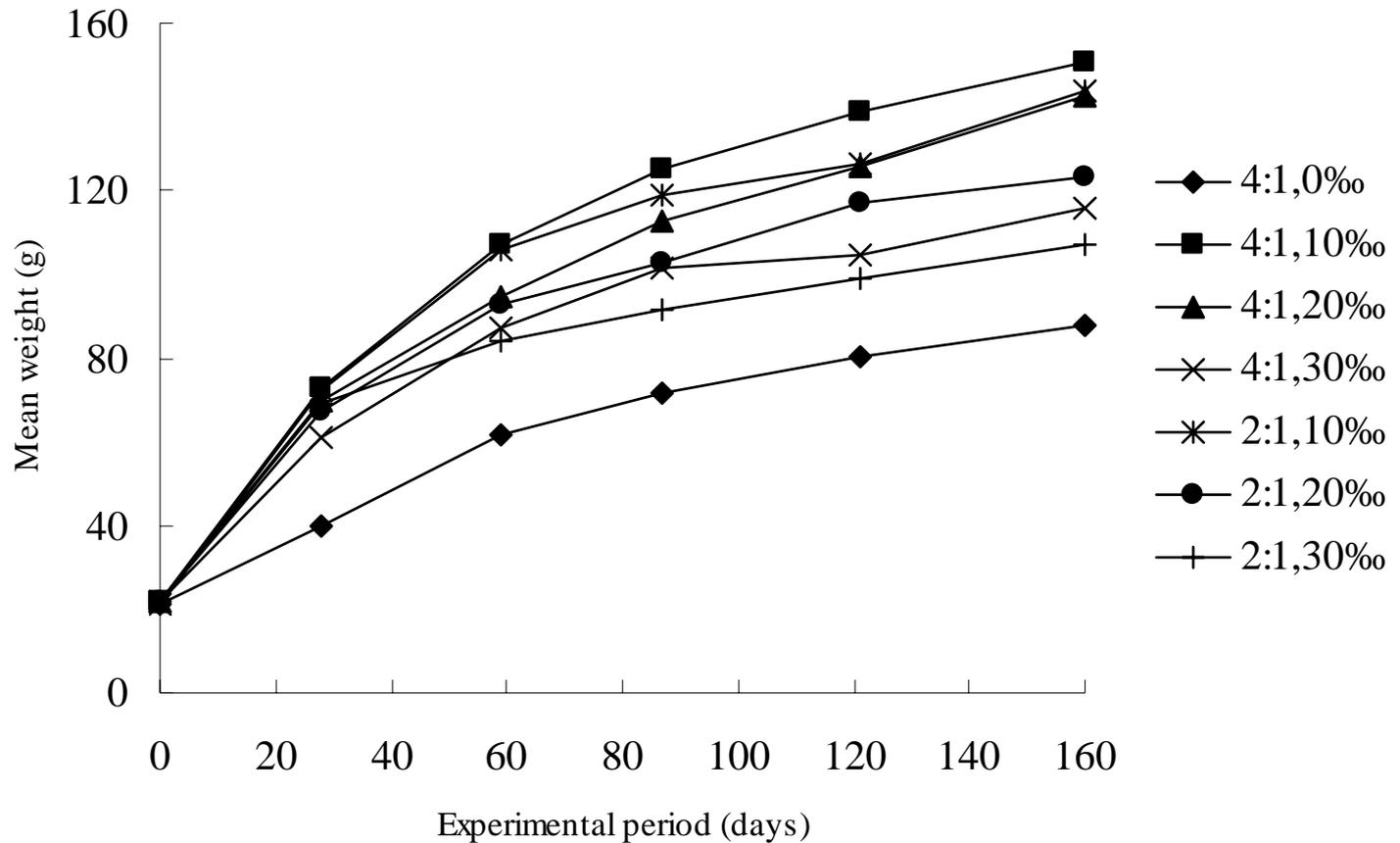
- *Fish*: individual weight and length of 50% stocked population biweekly; all fish were harvested in 160 days. Results were expressed in daily weight gain (g fish/d), yield (kg/pond)
- *Water quality*: analyzed biweekly at 0900 h for:
 - Bi-weekly*: pH, alkalinity, total ammonium nitrogen (TAN), nitrite nitrogen, nitrate nitrogen, total Kjeldahl nitrogen (TKN), soluble reactive phosphorus (SRP), total phosphorus (TP), chlorophyll *a*, total suspended solids (TSS), and total volatile solids (TVS), Secchi disk visibility, temperature(C) and dissolved oxygen (DO)
 - Diel (monthly)*: temperature, DO and pH at 0600, 1000, 1400, 1600, 1800, and 0600 h

RESULTS

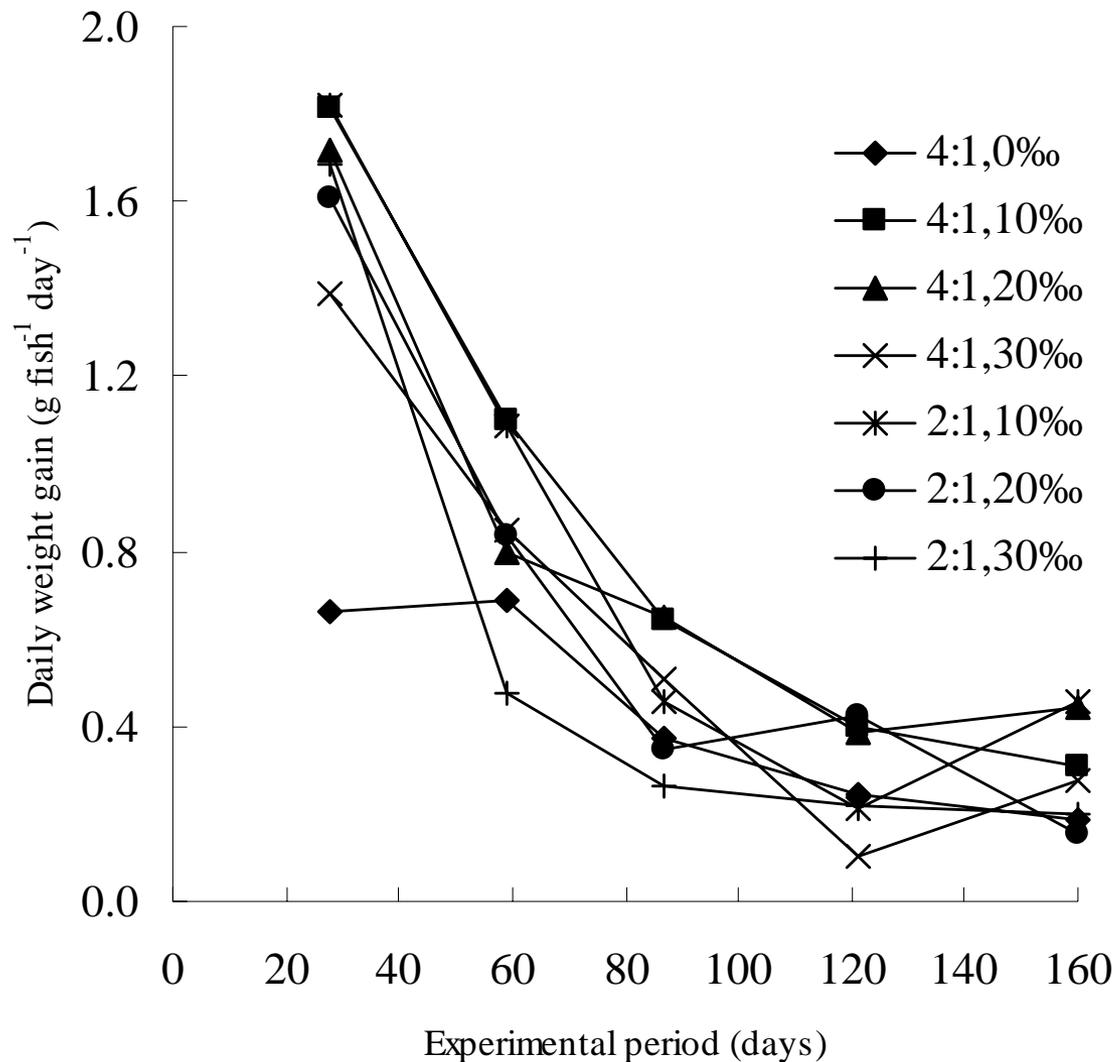
Fish Growth Performance

Parameters	Salinity and Fertilization Rate						
	N:P=4:1				N:P=2:1		
	0‰	10‰	20‰	30‰	10‰	20‰	30‰
Stocking							
Density (fish m ⁻²)	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Total number (fish tank ⁻¹)	12	12	12	12	12	12	12
Mean weight (g fish ⁻¹)	21.4±0.3	22.0±0.4	21.6±0.3	21.9±0.9	21.5±0.6	22.0±0.2	22.1±1.0
Total weight (kg tank ⁻¹)	0.26±0.00	0.26±0.00	0.26±0.00	0.26±0.01	0.26±0.01	0.26±0.00	0.26±0.01
Harvest							
Total number (fish tank ⁻¹)	12±0	12±0	12±0	12±0	12±0	12±0	12±0
Mean weight (g fish ⁻¹)	87.5±11.7 ^a	150.5±9.2 ^c	142.8±17.0 ^{bc}	115.6±11.0 ^{abc}	144.0±14.3 ^{bc}	123.1±6.1 ^{abc}	106.8±10.0 ^{ab}
Total weight (kg tank ⁻¹)	1.05±0.14 ^a	1.81±0.11 ^c	1.71±0.20 ^{bc}	1.39±0.13 ^{abc}	1.73±0.17 ^{bc}	1.48±0.07 ^{abc}	1.28±0.12 ^{ab}
Survival Rate (%)	100	100	100	100	100	100	100
Daily weight gain (g fish ⁻¹ d ⁻¹)	0.41±0.07 ^a	0.80±0.06 ^c	0.76±0.11 ^{bc}	0.59±0.06 ^{abc}	0.77±0.09 ^{bc}	0.63±0.04 ^{abc}	0.53±0.07 ^{ab}
Total weight gain (kg tank ⁻¹)	0.79±0.14 ^a	1.54±0.11 ^c	1.45±0.21 ^{bc}	1.12±0.12 ^{abc}	1.47±0.17 ^{bc}	1.21±0.07 ^{abc}	1.02±0.13 ^{ab}
Net yield (t ha ⁻¹ year ⁻¹)	3.62±0.64 ^a	7.04±0.48 ^c	6.64±0.95 ^{bc}	5.13±0.56 ^{abc}	6.71±0.76 ^{bc}	5.53±0.33 ^{abc}	4.64±0.58 ^{ab}
Gross yield (t ha ⁻¹ year ⁻¹)	4.79±0.64 ^a	8.24±0.50 ^c	7.82±0.93 ^{bc}	6.33±0.60 ^{abc}	7.88±0.78 ^{bc}	6.74±0.34 ^{abc}	5.85±0.54 ^{ab}

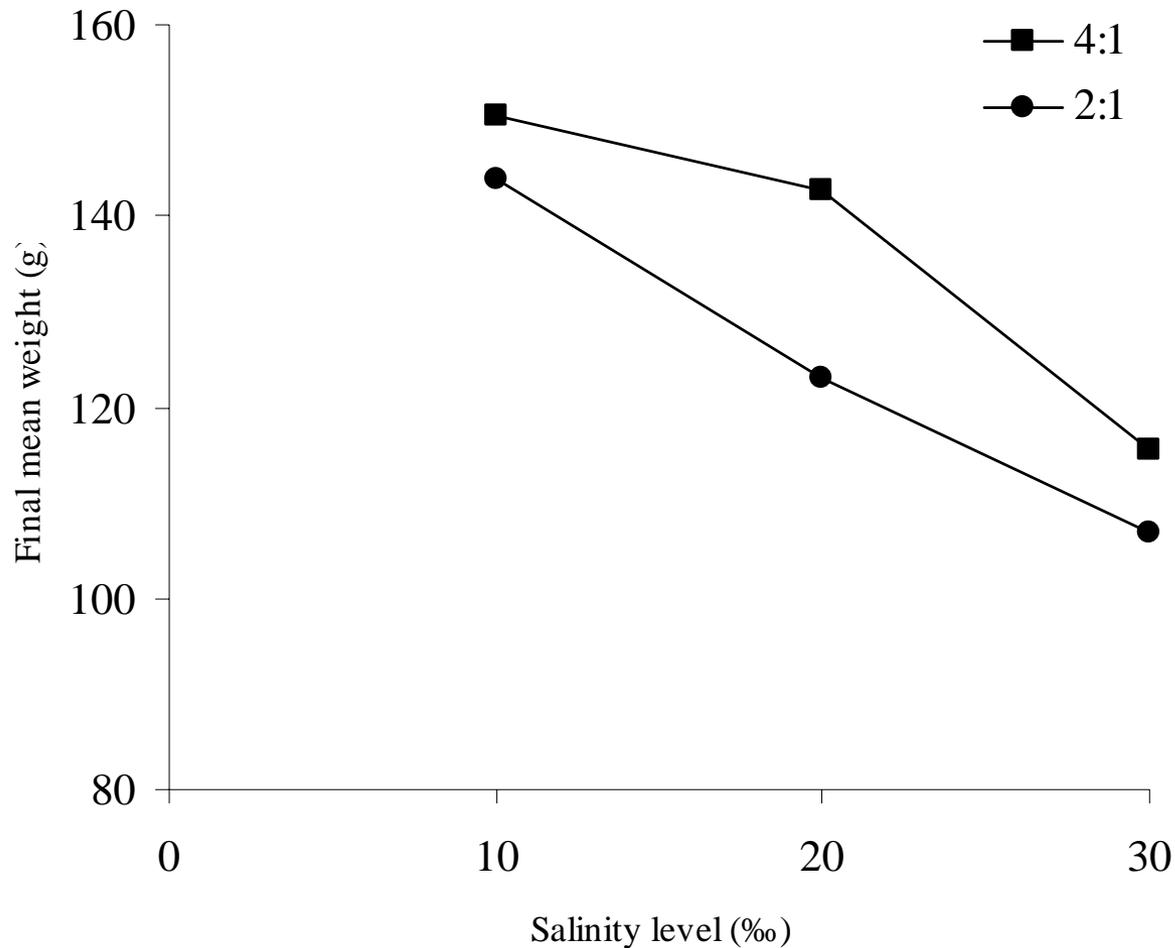
Harvested Fish Mean Weight



Daily Weight Gain



Final mean weight at different salinity levels under two fertilization rates



Water quality

Mean (+ SE) values of water quality parameters measured throughout the experiment.

Parameters	Salinity and Fertilization Rate						
	N:P=4:1				N:P=2:1		
	0‰	10‰	20‰	30‰	10‰	20‰	30‰
DO at dawn (mg L ⁻¹)	5.40±0.26	5.74±0.17	5.04±0.19	4.77±0.16	5.63±0.20	5.07±0.20	5.00±0.17
Temperature (C)	28.2-32.7	28.1-32.7	28.2-32.7	28.2-32.7	28.2-32.7	28.3-32.7	28.1-32.7
<i>pH</i>	7.1-11.1	6.4-10.2	6.3-10.0	6.1-9.6	5.7-11.0	6.7-10.2	6.4-9.8
Alkalinity (mg L ⁻¹)	46.5±1.4 ^a	27.6±2.9 ^b	29.7±1.6 ^b	22.9±1.2 ^b	29.3±2.7 ^b	27.8±2.9 ^b	27.8±6.8 ^b
TAN (mg L ⁻¹)	0.02±0.00 ^a	0.05±0.00 ^a	0.05±0.00 ^a	0.09±0.01 ^b	0.04±0.01 ^a	0.04±0.01 ^a	0.05±0.02 ^a
Nitrite-N (mg L ⁻¹)	0.38±0.03 ^{abc}	0.44±0.01 ^c	0.42±0.02 ^{bc}	0.39±0.04 ^{abc}	0.35±0.03 ^{ab}	0.31±0.02 ^a	0.31±0.04 ^a
TP (mg L ⁻¹)	0.83±0.13	0.52±0.07	0.56±0.02	0.41±0.07	0.47±0.05	0.53±0.09	0.61±0.17
SRP (mg L ⁻¹)	0.56±0.16	0.30±0.07	0.35±0.03	0.20±0.06	0.26±0.05	0.30±0.08	0.44±0.19
Chlorophyll <i>a</i> (mg m ⁻³)	62±15.0	53±3.4	57±7.5	72±1.4	58±3.7	68±9.0	69±7.1

Conclusions

- Thai red tilapia grew best at 10 ppt brackishwater than freshwater and higher salinity in present experimental conditions
- There is no significant difference in fish growth between two fertilization rate at all salinity levels; no conclusive recommendation on optimal fertilization rate can be made for saline water ponds
- The fish growth rate is sub-optimal compared to *O. niloticus* in freshwater open pond at the same fertilization rate
- The phytoplankton production is considerable lower than that in the freshwater ponds at the same fertilization rates
- There is no obvious water quality problems, except wide pH fluctuation, which perhaps due to low alkalinity
- Precaution needs to be taken to extrapolate results from small tank experiments to real production ponds
- Further research is needed based on large earthen brackishwater ponds

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