Effects of Different Stocking Density on Growth Performance and Economic Returns of River Snail (*Filopaludina martensi*) Raised in Small-Scale Cage Culture

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Abstract : The effects of stocking density on growth performance and economic returns of river snail (*Filopaludina martensi*) cultured in experimental cages was conducted using the Complete Randomized Design (CRD) with 3 replicates of 3 different stocking densities (SD; 50, 100 and 150 snails/m^2). Snails with initial average size of 2.06-2.615 g (body weight), 12.32-12.73 mm in width, and 17.90-18.48 mm in length were stocked in 1 x 1 x 0.9 m^3 cages for 16 weeks. Results showed that SD had no significant influence on growth performance of the snail. Final weight (3.91±1.16, 3.85±1.35 and 3.64±0.98 g), width (17.33±3.04, 15.72±1.90 and 15.50±1.93 mm.) and length (25.76±2.55, 25.27±2.23 and 24.91 ± 3.59 mm.), in respect to SD level, were not significantly different among SD treatments (P>0.05). Survival rates were also not significantly different among the treatments (93.33±1.53, 93.00±1.73 and 92.89±8.33%, respectively). The results also revealed that the 150 snails/m^2 cage-cultured river snails contributed significantly higher return on investment (60.32±37.17%) in comparison to both 50 (-15.84±16.44%) and 100 snails/m^2 (21.53±16.53%), both of which were not significantly different from each other.

Keywords : river snail, *Filopaludina martensi*, stocking density, cage culture, return on investment

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1. **Introduction**

River snail *(Filopaludina martensi* or Hoy khom in Thai), an aquatic gastropod mollusk with a gill and operculum is a species of large freshwater snail. It is classified in the family Viviparidae. Snails are soft-bodied animals, covered with them a protective shell. Freshwater resources such as pond, ditch, canal, swamp and ditch in rice field with 10 cm-depth to 2 m-depth water, coupled with sandy loamy soil or mud and temperate and confined water or lentic water is considered to be a sufficient habitat for river snail (Karnphoem and Wannapat, 2004).

The adult size of river snail is 3.2 – 4.5 cm in length and 1.8 – 3.5 cm in width. One female snail lay 5 to 40 eggs. A juvenile snail will cover with clear gelatinous clutches that can easily exceed. From December to July, a number of juvenile snails are found (Karnphoem and Wannapat, 2004). Not surprisingly, river snails are widespread, common encountered and rarely of conservation importance. River snail has already been promoted for economic purposes (Karnphoem and Wannapat, 2004).

River snail has been recognized as a fresh material for daily Thai cuisine (Nadjinda, 2009). Its flesh has been consumed by humans worldwide since prehistoric times and is known as a rich source of protein (12 - 16%) and iron (45 - 50 mg/kg) as well as low in fat, and contains almost all the amino acids for humans (Karnphoem and Wannapat, 2004). A recent study has also shown that the nutrition substances in the edible snail flesh cause agglutination of certain bacteria, which could be of value in fighting a variety of ailments, including whooping cough (Cobbinah, 2008).

Most snail productions are found from natural resource, while little is by product of fish farm. However, an unstable production can be observed from those resources. In order to gain continuous profit, cages culture is an optional for aquatic farmers due to fast reproduction, and excellent in environmental adaptation (Choochote and Poondee, 1983; Karnphoem and Wannapat, 2004).

The study of raising river snail in cages has emerged an attractive for researchers due to various utilization of river snail in particular food. There are numerous dishes such as river snail boiled with coconut milk (Gang Kua Hoy Khom) and other dishes are wll-known by consumer (Nadjinda, 2009). This would be a great way for aquatic farmer to get profit. Therefore, the present study aimed to study the effects of different stocking density on growth performance, survival rate and economic returns of river snail (*Filopaludina martensi*) raised in small-scale cage culture, which is believed to being more pronounce in management and collecting production compared to earthen pond.

2. Materials and Method

Small-scale cage construction

The soil small-scale cage with a volume of 1,200 m^2 and 1 m in width, 1 m in length and 0.9 m in height were constructed. Cages were then hanged into 50 cm in depth water. Four pieces per cage of coconut leaf stalk (9o cm length, 80 cm-width) were then submerged into water in order to create an adhesive place, a shelter and food source for the river snail.

River snail collection

River snails were collected from natural habitat of Rajamangala University of Technology Isan (RMUTI), Surin Campus. They were then sizing, weighted and measured (width and length). The similar size of river snails were considered to raise in 9 cages with the initial average weight of 17.90-18.40 g, the average width 2.06-2.15 cm and the average length 12.32-12.73 cm with respect to treatments (treatment 1: 50 snails/m^2; treatment 2: 100 snails/m^2) and treatment 3: 150 snails/m^2).

Economic Evaluation

Information on the production costs including purchasing cost, depreciation cost and income were recorded. Economic Returns were further analyzed (Prajakwong and Siripun, 1989).

Water properties testing

Water samples were collected between 09.00 and 12.00 PM every two weeks; and temperature, pH value, dissolved oxygen, alkalinity and hardness according to APHA-AWWA-WEF method (1992) were recorded.

All experiments were conducted at the laboratory of Fisheries Department, Faculty of Agriculture and Technology, Rajamangala University of Technology Isan (RMUTI), Surin Campus started from July 2012 to October 2012 (up to 4 months).

3. Results and Discussion

Water Properties

Water was collected from internal and external cages during 09.00 – 12.00 PM every 2 weeks and further analyzed with regards to their chemical and physical properties. For internal cage, the temperature was 25.09 – 28.51°C, dissolved oxygen 2.42 – 6.25 mg/L, pH value 6.68 – 7.64, alkalinity 72 – 80 mg/L and hardness of 55 – 60 mg/L. In case of external cage, the temperature was about 25.09 – 28.51°C, dissolved oxygen 3.52 – 6.85 mg/L, pH value 6.84 – 7.75, alkalinity 72 – 81 mg/L and hardness 55 – 62 mg/L, which were considered to be an optimal condition for aquatic animal growth (Boyd, 1990).

Growth of River Snail

Growth performance of river snail based on length, width and weight, growth rate per day and survival rate were not different among the test densities (50, 100 and 150 snails/m^2), 4 months (16 weeks) after the initiation of the experiment (($p>0.05$; Table 2).

However, river snails had the greatest growth rate at the density of 50 snails/m^2, the similar result was observed by Karnphoem and Wannapat (2004). The study highlighted the density of 100 snails/m^2)

obtained highest growth rate of river snail in a comparison to other densities (100, 200, 300, 400 and 500 snails/m^2, respectively). Moreover, survival rate was not significant different ($p>0.05$). The density of 50 snails/m^2 gave the maximum average survival rate at 93.33±1.53%. In agreement with Karnphoem and Wannapat (2004) reported the maximum average survival rate of 99.33±0.58% at 100 snails/m^2 stock density and death rate decreased at higher density of river snail.

Number of juvenile during the experiment

Of three stock densities (50, 100 and 150 snail/m^2), a number of juvenile snails were found at week six by which 150 snails/m^2 showed the greatest average of juvenile snails at 582.33±93.20 snails/m^2. The result was not significantly different compared to 100 snails/m^2 ($p>0.05$) at 508.67±104.26.

The average number of river snailleeet/snail at stock densities 50, 100 and 150 smails/m^2 gave the average number of junile snails 5.77±1.09, 5.09±1.04 and 3.88±0.64, respectively. There was no significant difference among the test treatment ($p>0.05$) (Karnphoem and Wannapat, 2004).

Yield Productions of River snail

For 150 snails/m^2 stock density, the average weight of river snails was 464.75±22.75 g/m^2, followed by 100 snails/m^2 stock density (358.29±42.33 g/m^2) and 50 snails/m^2 stock density (161.84±8.51 g/m^2), with no significant different found ($p<0.05$).

Yield of river snail raised at 150 snails/m^2 stock density had the highest average weight at the level of 1096.80±395.20 g/m^2, 100 snails/m^2 (843.87±168.79 g/m^2 and 50 snails/m^2 (576.03±135.92 g/m^2). All stock densities were not significant difference ($p>0.05$).

For the total average weight of yield per square meter, the highest average weight was found in 150 snails/m^2 (1,561.55±414.92 g/m^2). This result showed significantly difference ($p<0.05$), when compared with 50 snails/m^2 (average weight 737.87±134.78 g/m^2. However these two densities were not significantly different from the density 100 snails/m^2 (1202.16±200.79 g/m^2, $p>0.05$).

Production cost and economic return

At the end of week 16, the stock density of 50 snails/m^2 contributed the negative economic return, -15.84±16.44 Bath/m^2. There was significant difference ($p<0.05$) of economic returns (21.53±16.53 Bath/m^2) in case of 100 snails/m^2 stock density. The highest economic returns at 60.32±37.17 Bath/m^2 was found for 150 snails/m^2 stock density. In comparison, 100 and 150 snails/m^2 stock density were not significant different ($p>0.05$). The density of 150 snails/m^2 showed the greatest economic return, which higher production cost per cage increased when the density of river snail increased. The similar trend was also reported by Karnphoem and Wannapat (2004).

4. Conclusions

There was no significant difference observed in growth rate and survival rate at the stock density of 50, 100 and 150 snails/m^2. Maximum economic return was calculated at the stock density of 150 snails/m^2.

5. Acknowledgements

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Table 1 major parameters indicated water quality inside the cages

Parameter	Range in cage	Range out cage
Temperature (°C)	25.09-28.51	25.09-28.51
Dissolved oxygen (mg/L)	2.42-6.25	3.52-6.85
pH	6.68-7.64	6.84-7.75
Alkalinity (mg/L)	72-80	72-81
Hardness (mg/L)	55-60	55-62

Table 2 Growth performance and feed utilizations of the River Snail (*Filopaludina martensi*) raised in small-scale cage culture for 4 months (16 weeks) culture period (mean±SD)

Growth Performance	Stocking density (snails/m^2)		
	50	100	150
Initial weight (g)	2.10±0.38	2.06±0.24	2.15±0.27
Final weight (g)	3.91±1.16	3.85±1.35	3.64±0.98
Initial length (mm)	18.40±1.79	18.48±1.34	17.90±1.54
Final length (mm)	25.76±2.55	25.27±2.23	24.91±3.59
Initial width (mm)	12.32±0.68	12.73±0.37	12.60±0.57
Final width (mm)	17.33±3.04	15.72±1.90	15.50±1.93
Average daily growth:			
- weight (g/day)	0.016±0.007	0.016±0.009	0.014±0.005
- length (mm/day)	0.066±0.017	0.058±0.014	0.058±0.016
- width (mm/day)	0.042±0.022	0.028±0.012	0.026±0.012
Survival rate (%)	99.33±1.53	93.00±1.73	92.89±8.33

Note: Means with different superscripts in the same row are significantly different (p<0.05) by DMRT.

Table 3 Economic returns of the river snail production, raised in all experimental treatments

Item/cage	Cost (Baht/kg)		
	T1 (50)	T2 (100)	T3(150)
1. Cost (Thai; Baht)			
- Fixed cost	13.37	13.37	13.30
- Depreciation cost (120 Baht/cage 3 year	13.33	13.37	13.37
- Opportunity cost (interest 0.75 Baht/year)	0.03	0.03	0.03
- Variable cost	1.05	2.11	3.16
- Snail cost (10 baht/kg)	1.05	2.10	3.16
- Opportunity cost (interest 0.75 Baht/year)	0.003	0.005	0.008
2. Total production (baht/kg)	14.42	15.45	16.52
3. Income (Thai; baht)	12.13±2.36	18.80±2.55	26.49±6.14
4. Net income	11.08±2.37	16.07±2.55	23.33±6.14
5. Profit	-2.28±2.36	3.33±2.55	9.96±6.14
6. Return on investment (%)	-15.84±16.44^c	21.53±16.53^b	60.33±37.17^a

Note: Means with different superscripts in the same row are significantly different (p<0.05) by DMRT.