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Growth performance of freshwater Mud Eel, *Monopterus cuchia* in different ditches conditions

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Abstract

An experiment was carried out to observe the water quality parameters and growth performance of the freshwater mud eel, *Monopterus cuchia* at Uthrail union of Sadar upzila under Dinajpur district for six months in different ditches namely as T_1(concrete ditch), T_2 (tripal ditch) and T_3(normal ditch). Randomized Complete Block Design (RCBD) with three replication in each treatment was differentiated at significant level 0.05. Stocking density, feed and fertilization were same for each treatment. The average weights (gm) of the freshwater mud eel, *M. cuchia* in three treatments were was 316.7±1.8, 403.4±1.4 and 416±1.3, while an average length (cm) was 71.15±1.02, 73.07±0.59 and 75.13±0.88. It also found that the body weight (gm) gain was 221.05± 1.2, 305±0.9 and 318±1.5 while the body length (cm) gain was 16.87±0.8 cm, 17.61±1.2 cm and 18.02±1.09 cm at T_1, T_2 and T_3 respectively. The survival rate was observed maximum (99%) at T_2 and minimum was found (60%) at T_1. From the study, it can be observed that the highest growth performance of *Monopterus cuchia* was found in the normal ditch (T_3) but survival rate was the lowest. On the basis of survival rate and growth performance, it is suggested that T_2 (tripal ditch) is suitable for the culture of freshwater mud eel, *M. cuchia*.

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Introduction

Bangladesh is an agro-based development country because of striving hard for the rapid development of its economy (Ahmed, 1997). The amount of fish production was 41.37 lakh MT in the fiscal year 2016-17 in Bangladesh. Fish provides about 60% animal protein and 11% of people involves in the fisheries sector for their livelihood. Bangladesh earned 4287.68 million Tk. as export revenue from fisheries sector in 2016-17 (DoF, 2018). Freshwater mud eel or swamp eel, *Monopterus cuchia,* also known as *Kuchia or Kucha*. It belongs to the family Synbranchidae of the order Synbranchiformes and commonly occurs in freshwater of Bangladesh, Pakistan, Nepal, Mayanmar and throughout the India (Talwar and Jhingran, 1991). The mud eel (*M. cuchia*) is a carnivorous and nocturnal species, prefers animal-based food like small fishes, mollusks and worms etc. The mud eel is very tasty, nutritionally rich with medicinal value and highly priced in the other foreign markets. The average protein content of eel flesh is 14g/100g and the caloric value of eel flesh is as high as 303 Kcal/100g compared to110 Kcal/100g in other average fishes (Nasar, 1997).

Many poor people harvest and sell mud eel as a full-time or part-time profession. However, recently, due to the extreme amount of exporting mud eel has been reduced from nature faster than any other time in past abundance of this species. Nature has been decayed due to habitat destruction, aquatic pollution and indiscriminate uses of pesticides.

Though several researches have already been conducted such as Growth and yield performance of a sustainable aquaculture of *Monopterus cuchia* (Chakraborty *et al.*, 2017), technical and co-management aspects of mud eel culture (Chakraborty *et al.*, 2010), rearing and production performance (Miah *et al.*, 2015), effect of different shelters and feeds on growth, survival and production (Narejo *et al.*, 2003), effect of different temperature on food, growth and survival rate (Rahman *et al.*, 2005). It is commercially important due to its high demand for export and the value of earnings has been steadily increasing. The demand of supplying this species is increasing day by day but no technology for commercial culture and production of mud eel is developed so far in Bangladesh. However, there is a lack of enough information regarding growth performance of mud eel in different ditches. Thus, this study was aimed to investigate the growth performance in the different types of ditches of mud eel.

Material and methods

Experimental site and design

The study was carried out for a period of six months from 1 July to 30 December, 2017 in nine different constructed ditches such as T_1 treatment (concrete ditch), T_2 treatment (Tripal ditch) and T_3 treatment (Normal ditch) located at Uthrail union in Dinajpur sader upazila, Dinajpur district, Bangladesh. The ditches were maintained about 24 feet long, 12 feet wide in size and around 3 feet depth throughout the study period.

Experiment procedure

Concrete ditches were made of cement, brick and sand mixed like casting. When casting was hard, than applied the first layer 10cm clay soil layer (80% of clay soil and 20% of the loamy soil mixed), second layer was made of 10 cm lime, dung, water hyacinth and straw mixed compost, third layer was made of 2-3 cm 7 days dry banana leaves and finally fourth layer 10cm volume clay layer (80% of clay soil and 20% of the loamy soil mixed). After drying the layer, liming (500 gm) was applied and filled with water. Finally, Water hyacinth was used on water to reduce the temperature.

Tripal ditches were dried and applied polythene and tripal as per ditch volume. The same four layers were applied on the tripal. A border was built in 40-50 cm wide around the ditch which was made of 80% clay soil. Next step was followed as concrete ditch. The normal ditches were dried and then followed as like concrete and tripal ditches.After preparation of all ditches, small fish fry was released for investigation only 2-4 days. If small fry was live, then ditches were

appropriate for mud eel culture. The small sizes of the freshwater mud eel, *Monopterus cuchia* were collected from local tribal. About 215 experimental mud eel was stocked each of the constructed ditches in the morning. Small dead fish, earthworms, small live fish (tilapia/carp fry), snails, small frog, chicken viscera, dry fish and aquatic insects were supplied. The feed was given in the night because *M. cuchia* was a nocturnal animal. The feed was given about 3-5% body weight.

Water quality parameters

Four physico-chemical parameters of ditches water were recorded *viz*., temperature, dissolved oxygen, pH and transparency were measured with an interval of 15 days during the whole period of study.

Temperature and dissolved oxygen were measured by using a mercury-in-glass thermometer and a dissolved oxygen meter (YSI model 58, USA), respectively. The pH was measured by using portable pH meter (model 56, NR 87 BB 203) (Rad *et al.* 2006) and the transparency of ditches water was determined using Secchi disc.

Growth parameters

During the period of the experiment, the mud eel were caught by using hand every 15 days later. The growth of mud eel was recorded by measuring the length (cm) and weight (gm) of the harvested eel by using a measuring tape and an electric balance, respectively.

Weight gain

Weight gain (W) was calculated through the following equation-Weight gain, $W = W_2 - W_1$

Where W_1 is initial weight and W_2 is final weight

Specific growth rate

The specific growth rate of mud eel under different treatments was calculated by using the following formula -

$$SGR\ (\%) = \frac{\text{In W2} - \text{In W1}}{\text{T}} \times 100$$

Where, $InW_2 - InW_1$ is the difference of logarithm of initial and final weight and T is the duration of the experiment (days).

Survival rate

The survival rate (SR) of mud eel was calculated as follow:

$$SR\ (\%) = \frac{\text{Final total number of fish}}{\text{Initial total number of fish}} \times 100$$

Statistical analysis

The data were analyzed by one-way ANOVA procedure of Statistical Analysis System (SPSS Windows Version 23). Treatment means were compared at $p<0.05$ according to the Tukey test and Least Significant Difference (LSD).

Result and discussion

Mean levels of physic-chemical parameters over the six months culture of *Monopterus cuchia* are presented in Table 1.

Table 1. Variations in water quality parameters of ditches water under different treatments.

Parameters	Month	Treatments			
		T_1	T_2	T_3	*P- Value*
Temperature	July	22±0.5	20.5±0.7	20.1±0.4	0.174
	August	24.7±0.7	22.6±0.9	22.3±0.2	0.008
	September	31±0.2	28.5±0.2	28±0.5	0.011
	October	30.4±0.8	27.8±0.9	27.4±0.8	0.008
	November	25.7±0.4	25±0.9	24.7±0.4	0.237
	December	17.1±0.4	20.6±0.8	20.3±0.9	0.001
Transparency	July	30.9±1.5	28±1.4	27.4±1.9	0.000
	August	32.6±1.2	29.4±1.6	28.6±1.6	0.000
	September	34.9±1.5	32.7±1.2	31.8±1.8	0.011
	October	33±1.4	31±1.4	30±1.4	0.048
	November	31.6±1.6	30.2±1.5	28.6±1.5	0.007

	December	30.1±1.8	28.9±1.4	26.6±1.6	0.001
Dissolved oxygen	July	4.6±0.2	5.2±0.1	5.1±0.9	0.030
	August	4.5±0.1	4.9±0.2	4.8±0.5	0.031
	September	4.2±0.2	4.5±0.3	4.4±0.2	0.220
	October	4.3±0.1	4.8±0.5	4.8±0.2	0.014
	November	4.3±0.1	5.1±0.9	5.1±0.4	0.001
	December	4.8±0.2	5.3±0.5	5.4±0.4	0.006
pH	July	7.2±0.1	7.55±0.2	7.4±0.1	0.027
	August	7.6±0.2	8.0±0.2	7.9±0.2	0.014
	September	8.1±0.2	8.4±0.1	8.2±0.2	0.013
	October	7.9±0.5	8.1±0.1	8.3±0.2	0.037
	November	7.4±0.1	8.05±0.3	8.1±0.4	0.015
	December	7.5±0.2	8.0±0.2	7.6±0.1	0.004

P- Value indicates significantly different (P<0.05) based on one-way ANOVA followed by Tukey test.

The individual average weight (416±1.3 gm) was the maximum at T_3 and the minimum individual average weight was 316±1.8 gm at T_1 treatment. It was also found that the maximum individual average length was 75.13±0.88 cm at T_3 treatment and the minimum individual average length (71.15±1.02 cm) was found at T_1 treatment (Table 2).

Table 2. Growth performance of *Monopterus cuchia* (Mean±SD) in different treatments over the experimental periods.

Species		Item	Treatments		
			T_1	T_2	T_3
Monopterus Cuchia	Initially	No. of mud eel	215	215	215
		Av. Individual weight of mud eel (gm/eel)	98±9	98±10	98±8
		Av. Individual total length of mud eel (cm/eel)	55±2.7	56±1.8	57.2±2.6
	Finally	No. of mud eel	130	212	155
		Av. Individual weight of fish (gm/eel)	$316.7±1.8^c$	$403.4±1.4^b$	$416±1.3^a$
		Body weight gain (gm/eel)	$221.05±1.2^c$	$305±0.9^b$	$318±1.5^a$
		Av. Individual total length of fish (cm/eel))	$71.15±1.02^c$	$73.07±0.59^b$	$75.13±0.88^a$
		Body length gain (cm/eel)	$16.87±0.8^c$	$17.61±1.2^b$	$18.02±1.09^a$
		Specific growth rate (%growth)	$0.64±0.4^c$	$0.73±0.4^b$	$0.79±0.5^a$
		Survival rate (%)	$60\%^c$	$99\%^a$	$72\%^b$

$^{a-c}$ mean values with different superscripts letters in the same row indicate a significant difference (p<0.05) based on one-way ANOVA followed by Tukey test.

After six months of cultivation, the maximum body weight gain (318±1.5 gm) was found at T_3 treatment while the minimum body weight gain (221.05±1.2 gm) was found at T_1 treatment (Figure 1). Therefore, the maximum body length gain (18.02±1.09 gm) was found at T_3 treatment while the minimum body weight gain (16.87.±0.8 gm) was found at T_1 treatment (Figure 2).

The temperature, water transparency, pH and dissolved oxygen of the experimental ditches were within the acceptable range for mud eel culture that agrees well with the findings of Chakraborty *et al.* (2017), Chakraborty *et al.* (2010), Narejo *et al.* (2003) and Miah *et al.* (2015). Narejo *et al.* (2003) reported that the optimum temperature was 22-31°C for increasing mud eel growth performance. Nasar (1997) reported that the optimum temperature for the suitable rearing of *M. cuchia* was between 20 to 35°C. *Anguilla* sp. does not take meal properly at 12°C (Usui, 1974). Chakraborty *et al.* (2017) found that the secchi disk transparency was suitable in the treatment

T_3 (22.33cm) for cuchia culture. Chakraborty *et al.* (2010) also found that the transparency was appropriate for cuchia culture between 14.80-20.50 cm in a rice field and 13.60-18.40 cm in ponds. Narejo *et al.* (2003) found that the dissolved oxygen values were found between 3.7 to 4.15 mg/l. Chakraborty *et al.* (2010) recorded that the pH value was 5.50-7.20 in a rice field and 5.88-7.40 in ponds. Narejo *et al.* (2003) found that the range of pH value was 7.35-7.55.

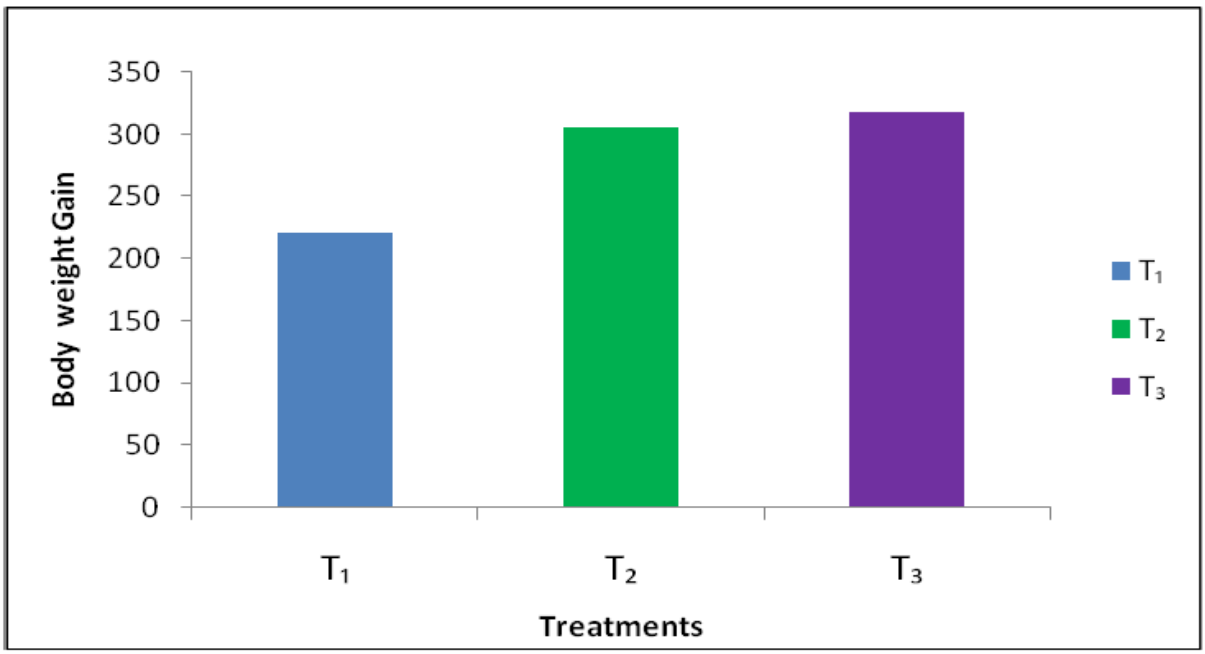

Fig. 1. Weight of *Monopterus cuchia* at different treatments.

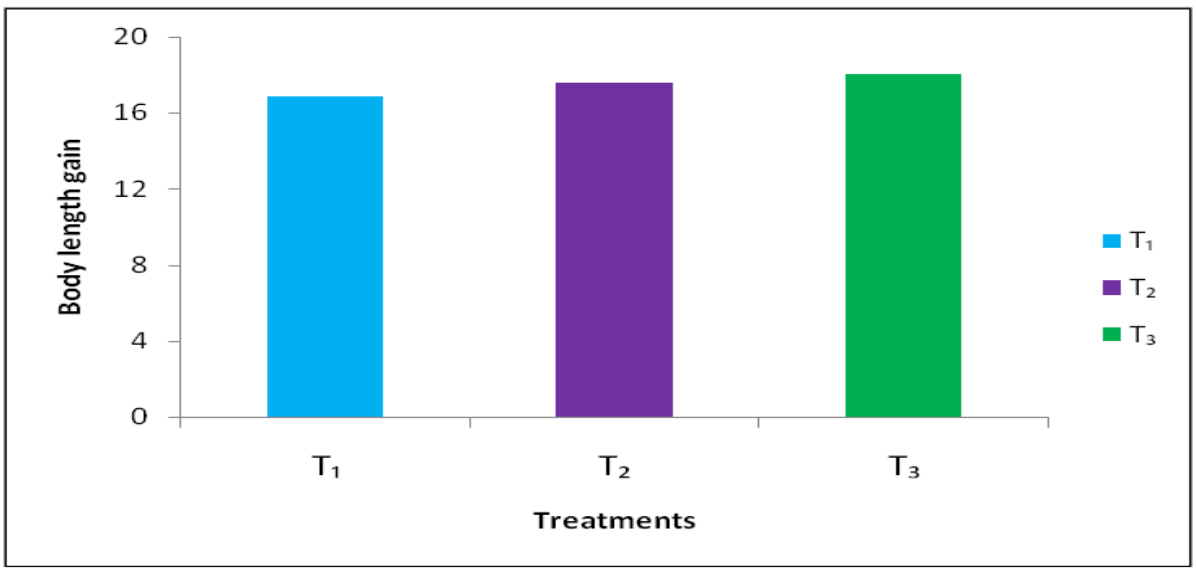

Fig. 2. Length of *Monopterus cuchia* at different treatments.

The body weight gain of mud eel was 221.05±1.2 gm, 305±0.9 gm and 318±1.5 gm in three different prepared ditches T_1, T_2 and T_3 treatment. Chakraborty *et al.* (2010) recorded that the body weight gain was 214.67±0.98 gm and 144.04± 0.84 gm. The body length gain was 16.87± 0.8 cm, 17.61± 1.2 cm and 18.02± 1.09 cm in three different prepared ditches T_1, T_2 and T_3 treatment. Narejo *et al.* (2003) recorded that body weight gain was 53.80± 0.65 gm in mud, 82.63± 5.80 gm in Water hyacinth, 34±1.0 gm in PVC pipes and finally 24.93± 0.89 in control. The present results might not be similar to the findings due to

environment, culture period, feed, stocking density etc.

The specific growth rate was high at T_3 compare to the T_1 and T_2 (Figure 3). The specific growth was 0.64±0.4%, 0.73±0.4% and 0.79±0.5% which was more or less similar to Chakraborty *et al.* (2010). Chakraborty *et al.* (2010) were found that the specific growth rate of the freshwater mud eel was 0.79±0.23% in a rice field and 0.61±0.32 in ponds, respectively.

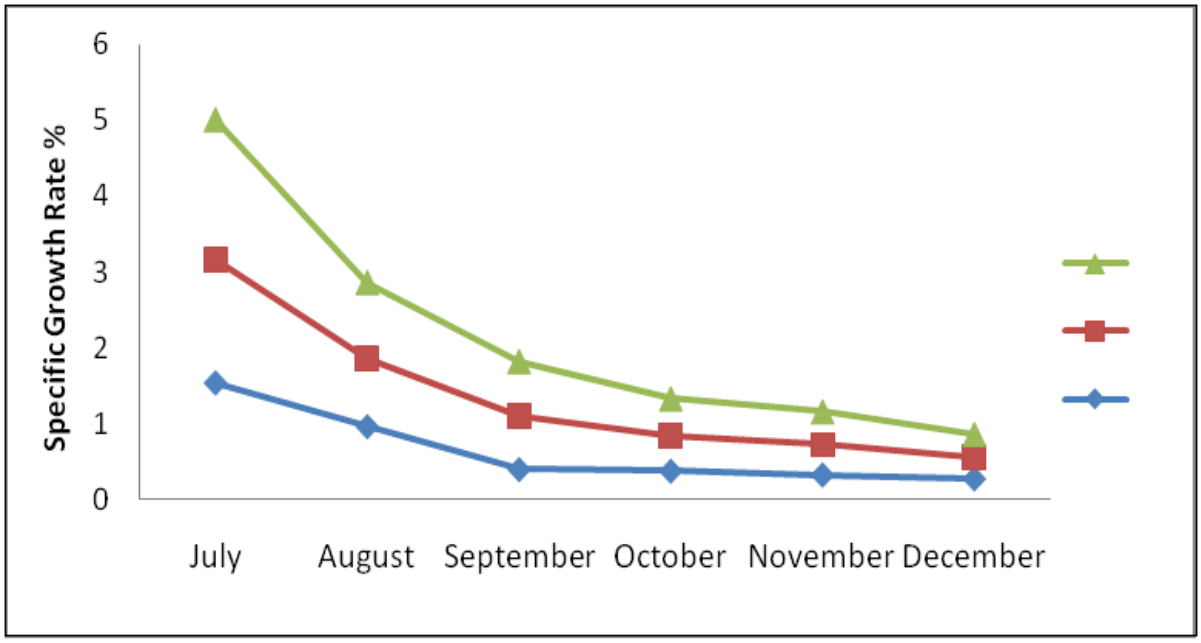

Fig. 3. Monthly variations of the specific growth rate of *M. cuchia* in different treatment.

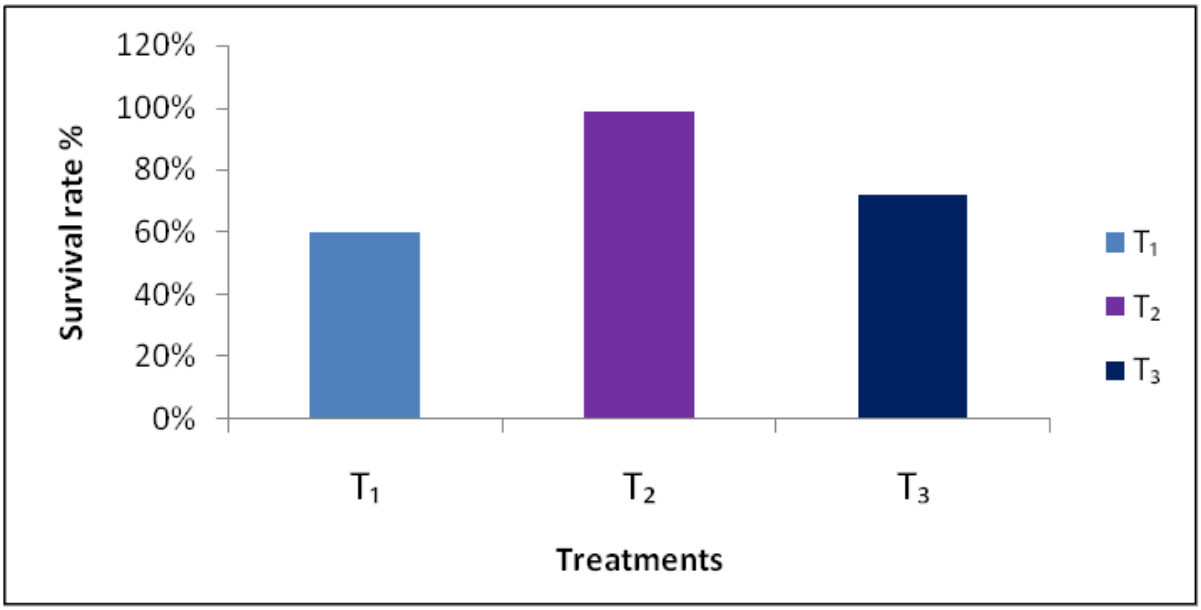

Fig. 4. Survival rate of *M. cuchia* in different treatments.

At the end of the experiment the highest survival rate (99%) was observed in T_2 and the lowest survival rate (60%) was recorded in T_1 while the rate of survival (72%) was found in T_3 (Figure 4). The survival rate was recorded at 60%, 99% and 72% which was near to Chakraborty *et al.* (2017). Chakraborty *et al.* (2017) observed that the highest survival rate was 96% and the lowest was 87%. The survival rate of the

freshwater mud eel was 90% in a rice field and 87.25% in ponds (Chakraborty *et al.* 2010).

Conclusion

The results of the study concluded that the maximum growth of the mud eel occurred at a temperature range of 20-35°C. The optimum dissolved oxygen and pH for the cultivation of the mud eel ranged between 4.2-5.4mg/l and 7.4-8.4 respectively. It also found that the range of transparency was ranged between 26-35 cm. The growth performance of the selected mud eel was the highest at T_3 treatment and the highest survival rate was 99% at T_2 treatment in contrast to T_1 and T_3 treatment. However, the growth rate was high but the survival rate was low at T_1, the survival rate and growth performance was also good at T_2. Finally the survival rate and growth performance was very low at T_1 treatment. So, this study suggests that the cultivation of the freshwater mud eel at tripal ditch (T_2) culture system will be more suitable in compared to the other normal ditch (T_3) and concrete ditch (T_1) culture system.

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