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THE EFFECTS OF DIFFERENT WATER FLOW RATES ON THE SURVIVAL RATE OF BLUE CRAB (*Portunus pelagicus*) ZOEA IV - MEGALOPA STAGES

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ABSTRACT

Blue crab (Portunus pelagicus) is a potential marine crustacean's commodity. The increase demand both local and international market of the blue crab result in the culture development of this species. The larval stage of blue crab, especially at zoea IV to megalopa, plays an important rule on the successful of the production of marketable size under culture condition.

Low survival rate of zoea IV to megalopa stage mostly due to their photo taxis behavior, thus, they are trapped at the water surface. Management of water flow rate on the zoea IV holding tank may be able to reduce their mortality rate and can reach megalopa stage successfully. The water flow rate management would keep the zoea in the suspension as well as improving the water quality, i.e. increases the dissolved oxygen in the water.

This investigation was done to find out the effects of different water flow rates on the survival rate of blue crab (Portunus pelagicus) zoea IV stage. The tested animal was blue crab at zoea IV stage which undergoes an investigation up to megalopa stage. An experimental method with a Completely Randomized Design was applied. The 5 (five) treatments of different water flow rates were used, i.e.: A (0,25 l/minute), B (0,5 l/minute), C (0,75 l/minute), D (1,0 l/minute), E (0,0 l/minute). Each treatment was replicated three times.

The results shows that different water flow rates gave a highly significant difference (P<0,01) on the survival rate of blue crab zoea IV - megaloga stage. The highest survival rate at the end of the experiment (at megalopa stage) was at treatment C (0,75 l/minute): 30,44%

Keyword: blue crab (*Portunus pelagicus*), zoea IV – megalopa stage; water flow, survival rate

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INTRODUCTION

Blue crab (*Portunus pelagicus*) is a potential marine crustacean's commodity. The demand of blue crab both local and international market increases and cannot be fulfilled due to the dependency on their natural catch/fishing. The USA demand on blue crab was 65.000 – 75.000 metric tones in 2005 (Kristianto, 2005). According to Directorate General of Fishing Depatment of Marine and Fisheries (2005) the blue crab fishing was only 35.000 – 40.000 metric tones and it was declining at the end of 2005. To fulfill the local and international demand on blue crab, therefore, rearing of this species is urgently needed. Cultivation of blue crab will also sustain the blue crab population in the sea.

Blue crab has several characteristics that make it possible to be grown under culture condition. These characteristics are: blue crab spawn all the year, 30-50% of captured female blue crab were berried female (brood stock), high fecundity and hatching rate. Most of all, blue crab larvae can be produced in captivity (Mardjono, 2002).

The main problem in blue crab rearing is seed supply. . The larval stage of blue crab, especially at zoea IV to megalopa, plays an important rule on the successful of the production of marketable size under culture condition. Low survival rate of zoea IV to megalopa stage mostly due to their photo taxis behavior, thus, they are trapped at the water surface. Management of water flow rate on the zoea IV holding tank may be able to reduce their mortality rate and can reach megalopa stage successfully. The water flow rate management would keep the zoea in the suspension as well as improving the water quality, i.e. increases the dissolved oxygen in the water. According to Ong (1964) the dissolved oxygen level needed for blue crab larval development was 4-6 mg/l respectively. Furthermore it was mentioned that the larval development would be disturbed when the DO level less than 3 mg/l.

The dissolved oxygen level is affected by several factors, such as temperature, salinity, partial gas pressure and water flow rate (Alabaster and Lloyd, 1980 *In* Hutagalung, 1988). It was mentioned further that the water flow rate in the holding tank can stabilize the temperature and dissolved oxygen in the water at the optimal condition. Furthermore, water flow rate will also able to distribute dissolved oxygen in the holding tank evenly and also increases the oxygen diffusion in the water (Landau, 1992 *In* Wulandari, 2002). Water flow rate may be able to reduce the mortality rate of blue crab zoea IV stage because of their planktonic and photo taxis behavior. The water flow is able to keep the zoea in the suspension.

MATERIALS AND METHODS

Materials.-- Blue crab of zoea IV stage were used as tested material and undergo the investigation until megalopa stage with carapace total length of 1–1,2 mm. The stocking density of the crab was 50 zoea IV/liter media. A plastic pale of 35 cm diameter, 20 cm depth was used as the holding tank with the water volume of 3 liters. So that there were 150 crabs zoea IV/holding tank the sea water at the salinity of 33 – 34 ppt was used as the media which was doubled sand filtered prior utilization. During the experiment, the blue crab zoea IV were fed using artemia nauplii at the ratio of ratio 20-50 artemia nauplii/crab/day, and was given twice a day.

The water header tank and the holding tanks were arranged in such away (**Fig. 1**) so that the water flow rate in each holding tank could meet the treatments applied.

Methods.-- An experimental method with a Completely Randomized Design was applied. The 5 (five) treatments of different water flow rates were used, i.e.: A (0,25 l/minute), B (0,5 l/minute), C (0,75 l/minute), D (1,0 l/minute), E (0,0 l/minute). Each treatment was replicated three times.

Data Collection.-- The survival rate data were collected at the end of the investigation (after 6 days) when the crab reach megalopa stage. While the water quality parameter included temperature, DO, pH were controlled and monitored daily.

Survival rate data of from crab zoea IV to megalopa stage was calculated following the formula (Effendi, 1997):

Data Analyses.-- The survival rate data were tested is homogeneity, additively and normality and then analyzed using Analyses of Variance (ANOVA) to find out the effects of treatments applied. If the treatments

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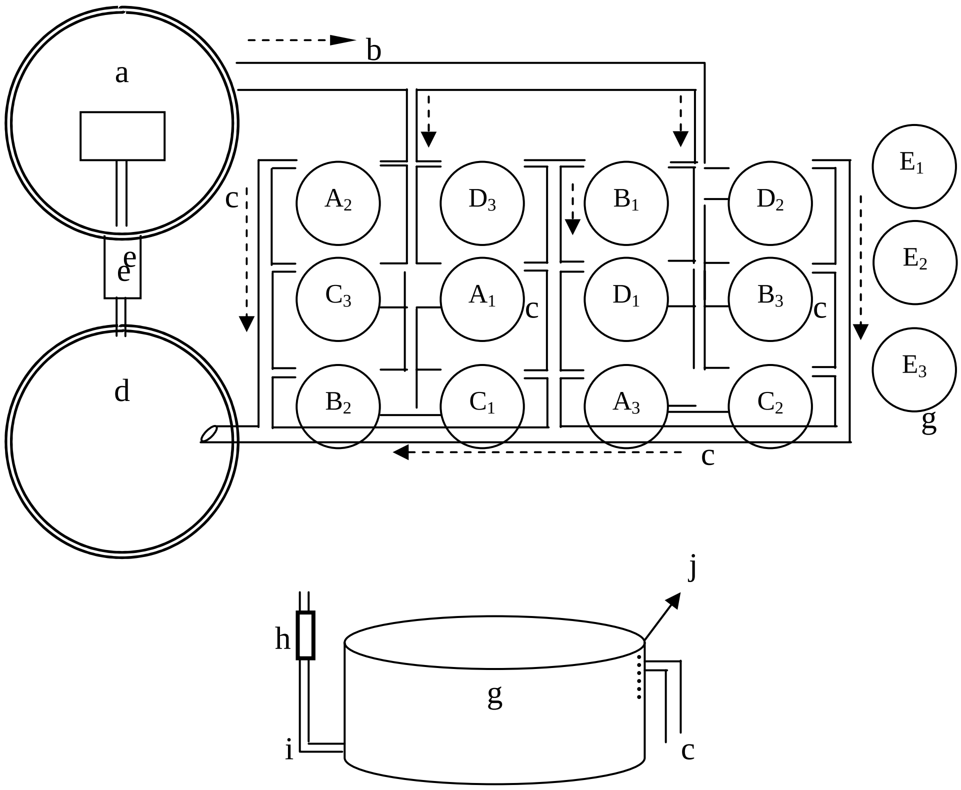

Fig 1. Header Tanks and Holding Tanks Lay Out Design: a. Inlet header tank; b. Inlet pipe; c. Outlet; d. Outlet header tank; e. Pump; f. Filter; g. Holding tanks; h. Infuse water; i. Inlet pipe flow regulator; j. Filter

$$SR = \frac{Nt}{No} \, x \, 100\%$$

SR = Survival rate (%)
Nt = Total number of megalopa
No = Total number of Zoea IV

showed a significant different, the survival rate data were analyzed further using multiple range Duncan Test. The water quality parameters were analyzed descriptively.

RESULTS AND DISCUSSION

Results.

Survival Rate.-- The survival rate data was collected at the end of the investigation, i.e. after 6 days. During 6 days investigation the zoea IV stage was already changed in to megalopa stage. The survival rate data at megalopa stage was shown in **Table 1**

It shows that the highest survival rate was found at treatment C (0,75 l/minutes): 30,44%, followed by treatment D (1,0 l/minute): 28,67%, B (0.5 l/minute): 17,77%, A (0.25 l/minute): 9,56% and the lowest survival rate was found at treatment E (0,0 l/minute): 6,67% as also shown by **Fig 2.**

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Table 1. Survival Rate Data (%) of Blue Crab (*P. pelagicus*) Megalopa Stage

Treatments	Replications			Average ± SD
	1	2	3	
A (0.25 l/minute)	11.33	6.67	10.67	9.56 ± 2.52
B (0.5 l/minute)	18	14	21.33	17.77 ± 3.67
C (0.75 l/minute)	31.33	26.67	33.33	30.44 ± 3.42
D (1,0 l/minute)	30	24.67	31.33	28.67 ± 3.52
E (0,0 l/minute)	9.33	4	6.67	6.67 ± 2.67

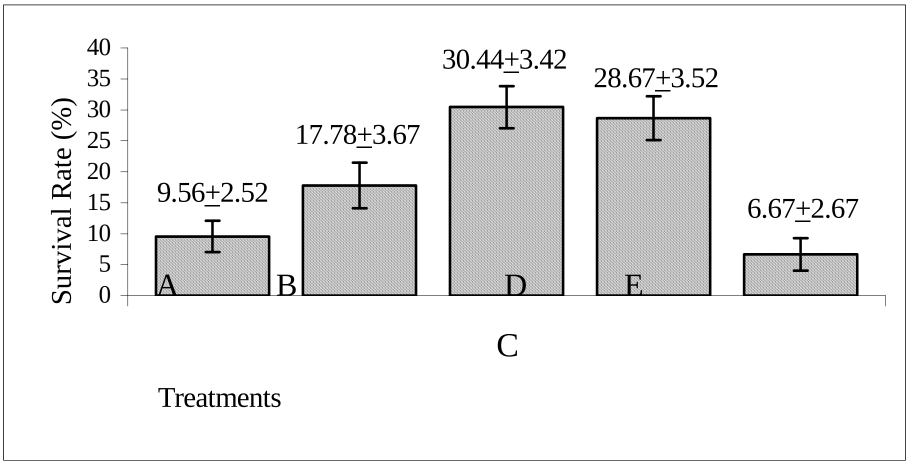

Fig 2. Histogram of Survival Rate Data of Blue Crab Megalopa Stage

Table 2. Analyses of Variance of Survival Rate Data of the Blue Crab Megalopa Stage

Source of Variance	Df	TSqr	MSqr	F calc	F_{tabel}	
					0.05	0.01
Treatmnents	1399.3923	4	349.84808	34.278 **	3.48	5.99
Error	102.0623	10	10.20623			
Total	1,501.4546	14				

** Highly Significant Different

The Analyses of Variance of survival rate data of the blue crab megalopa stage was shown in **Table 2.**

The analyses of variance shows that the treatments of water flow rates affected the survival rate of blue crab zoea IV – megalopa significantly (P<0,01)

A Multiple Range Duncan Test (**Table 3**) was applied to find out the significant different between treatments.

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Table 3. The Multiple Range Duncan Test of the Survival Rate Data

Treatments	Mean Value	Difference				
C	30.4433	C				
D	28.6667	1.7766	D			
B	17.7767	12.6666**	10.8900**	B		
A	9.5567	20.8866**	19.1100**	8.2200*	A	
E	6.6667	23.7766**	22.0000**	11.1100**	2.8900	E

**: Highly significant different; * : significant different

Water Quality Parameters.--The water quality parameters: temperature, pH, dissolved oxygen (DO) and ammonia were monitored and controlled to keep tolerable limit condition for the blue crab larvae. The water quality parameters range was presented at **Table 4.**

Tablel 4. Water Quality Parameters Range During the Investigation

Parameters	Observation	Tolerable Limit	Reference
Temperatures (^{o}C)	32 – 32.6	32 – 33	Suprapto and Hartoko, 1991
DO (mg/l)	4,28 – 5,88	5,03 – 8,80	Islamulhayati, 1984
pH	7,9 – 8.5	7,7 – 8,6	Cowan, 1984
Ammonia (mg/l)	0,0121 – 0,0306	< 0,1	Boyd, 1989

Discussion

Survival Rate.—The result of the research showed that the different water flow rate affected the survival rate of blue crab stage zoea IV-megalopa significantly (*P*<0,01), and the highest survival rate was found at treatment C (flow rate 0,75 l/minute): 30,44 % and followed by treatment D (flow rate 1 l/minute): 28,67%; B (flow rate 0,5 l/minute): 17,77%; A (flow rate 0,25 l/minute): 9,56% and the lowest was at treatment E (flow rate 0 l/minute): 6,67%. The different water flow rates would create the water movement which could help the larvae movement in the water column and could help them to prey the live natural food given. Different flow rates could also increase the dissolved oxygen content in the water, thus, could support the blue crab larva live. According to Landau (1992) *In* Wulandari (2002) the water flow rate could create aeration and increase the oxygen diffusion in the water, thus, increase the dissolved oxygen content, as well as could distribute oxygen in the water.

The highest survival rate at treatment C may be due to the proper water flow rate supplied (0,75 l/minute), i.e. neither not too strong nor too slow, so that the larvae could maintain themselves and kept their body balance in the suspension or in the water column. This assumption was supported by Effendi (1977) who mentioned that too strong water flow rate would affect the larvae lost their balance in the water column and crashed each other and the tank wall. As a result, this condition could result in their body damage and mortality.

On the other hand, the still water (0 l/minute) at treatment E showed the lowest survival rate: 6,67%. The highest mortality in the treatment E was assumed because most of the blue crab larvae were aggregated or accumulated in the bottom of the holding system. The high density of the blue crab in the bottom of the holding system could create cannibalistic amongst them since the natural food given, i.e. live artemia nauplii, were actively moving in the water column so that the blue crab larvae could not prey on them. Kasry (1991) mentioned that live natural food was needed by blue crab larvae

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for their live and growth. The highest mortality rate at treatment E was assumed due to the less dissolved oxygen content because there was no oxygen addition during the investigation, moreover the larvae were accumulated in that bottom of the holding system. As mentioned by Boyd (1989) that the dissolved oxygen concentration in the water was varied according to the water column, and the lowest concentration was in the bottom of the holding system.

Water Quality Parameters.—The water quality parameters during the investigation were monitored and controlled to keep the tolerable limit conditions for the blue crab larvae live and growth. Table 4 showed that the water quality parameters were still at the tolerable limit for blue crab stage zoea IV – megalopa live and growth (Cowan, 1984; Islamulhayati, 1984; Boyd, 1989; Suprapto and Hartoko, 1991)

CONCLUSSION

From the results of the research it could be summed up that:

1. Different water flow rates significantly affected the survival rate of blue crab stage zoea IV – megalopa
2. The best water flow rate was found to be 0,75 l/minute which could give the highest survival rate: 30,44% of blue crab stage zoea IV - megalopa

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