GROWTH PERFORMANCE OF GIANT EEL (ANGUILLA MARMORATA) AT HOA MY RESERVOIR, THUA THIEN HUE PROVINCE, VIETNAM

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Abstract: *Fingerlings's Giant eel (Anguilla marmorata) was selected for this research with average weight 115.25 ± 6,98 g/head, starting from October 5, 2010 to February, 2012 at Hoa My reservoir. This fingerlings were stocked in four floating cages with drilled holes Ø 1.5 cm, with size (3.0 x 1.5 x 1.0 meter each), suspended by plastic buoys and the fingerling stocking density were 240 head/cage and during this adaptation period, the changes of weight were recorded 1 time/ 2 months. Objective of this research is to find the suitable selection of using fresh trash fish or industrial feed to culture Giant eel in fresh water. As a result, the findings show that Hoa My reservoir likes potential area with stability of pH (6.8 – 8.2), DO (4 – 6mg /l). The temperatures fluctuating from 17.7 ^{0}C - 30 ^{0}C in the tolerance limit of this fish, do not effect on their growth performance. Giant eel using fresh trash fish reached 826.35 ± 61.35 g/head, gaining an income of 9.514.000 VND (320,000 VND/kg of fish) and Giant eel with industrial feeds only 538.4 ± 30.51g/head (290.000 VND per/kg of fish), loss of than 17.500.000 VND. This research suggest that farmer should use the fresh trash fish to culture the giant eel.*

Keywords: Hoa My reservoir, Giant eel, feed, economic efficiencies.

1. INTRODUCTION

Aquaculture has an important role in providing food security employment as the fastest growing food-production sector (Lowe et al. 2012) in local areas and on the global scale, fish provide the potential for environmental impacts (Edwards 2013) because the advantage of fish characteristic which requires less than 2 kilograms of feed for providing per kg product and it makes them the most efficiently producing aquatic animals based on feed and an amount of water use (Verdegem, Bosma, and Verreth 2006). Human population nowadays increases year by year and people refer to eat more the amount of fish because fish contain very high-quality protein and there are sufficient amounts of all the essential amino acids for a purpose of maintenance of lean tissues, liking important food for humans (Obe 2014), while natural fisheries resources diminish with the overexploitation of fisheries (Osofero, Otubusin, and Daramola 2009). The human requirement seems to promote an increasing fish market demand because of fish benefits. This activity leads to a shift towards aquaculture, creating balance the capture as well as culture production quantities (Ringuet, Muto, and Raymakers 2002). Campaigns are considered to solve this issue by developing the aquaculture sector in local area and country in order to reduce using the natural resource of fish.

According to the report on dam safety issued by the Ministry of Agriculture and Rural Development, there are more than 200 reservoirs in the central region of Vietnam (Khâm 2014). Hue Province has more than 50 reservoirs including irrigation lakes and hydroelectric reservoirs, Hoa My reservoir (9.67 million m^3) with the basin area of about 37 km^2, is one of largest reservoirs with a total capacity up to several billion m3 of water. This research is located at Hoa My reservoir because of two

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main reasons. Firstly, the reservoir seems uncontaminated water of excess nutrients, chemicals, and heavy metals because this reservoir is far from villages and cities. The second reason is that the reservoir provides the availability of the large volumes of water, it can supply water for commercial fish farming (Swann and Program 1914).

Giant eel can survive in saltwater, brackish water, fresh water. Giant eel (Anguilla marmorata) in this research is freshwater eels and one of 15-16 species of freshwater eels in family Anguilla, occurring at more than 150 different countries (Mizuno and Nagasawa 2010), (Hagi Yulia Sugeha and Sasanti R. Suharti 2013). This fish is selected for this research to portray the potential yield and an efficiency of economic at Hoa My reservoir, compared with traditional fish as silver carp, bighead, tilapia (Luong Quang Tuong and Nguyen Phi Nam 2017) and grass carp because Giant eel can grow up to 180 cm about total length and 28 kg in body weight.

In Giant eel life, the juveniles and adults stage grow in estuaries and freshwater, the adults return to oceanic to spawn and die. Their larvae, called leptocephali, return via surface waves to the estuaries, they grow into juvenile elvers, and then enter freshwater habitats as adults (Mccosker, Bustamante, and Wellington 1997). Like other anguillids, adults develop in freshwater or estuarine habitats, they are nocturnal, feed on a wide range of prey, especially crab, fish, frog. Giant eel like the dark, afraid of the light and then they like to be in caves or underground. Basing their characteristic, we nourish Giant eel in floating cage, we also put the small bamboo block inside, where has low light. At night time, Giant eel can go out to find food and move to another place. The wide range of temperature from 1-38°C is suitable for this fish habitat, but the temperature for rearing is 17 - 31°C is appropriate 22 - 28°C and Eels need high DO (dissolved oxygen) content in water, DO around 4,5ppm is suitable for their growth. In addition, skin and gut of this fish ability to breathe, if in transportation, we can keep the fish skin with moist and temperature 16°C, they able to live for a few days. These characteristics make Giant eel (Anguilla marmorata) as a suitable fish for culturing. In addition, Giant eel has high economic value and well known in the aquacultural market.

This research was supported by the Department of Science and Technology of Thua Thien Hue province in order to help local people by showing the high economic value from aquaculture activity in the water reservoir. The research title names **"Growth performance of Giant Eel (*Anguilla Marmorata*) at Hoa My Reservoir, Thua Thien Hue Province, Vietnam".** We implemented a research basing affecting of feed on the Giant Eel growth. This study was carried out for an objective:

- To compare the growth performance of Giant eel (Anguilla marmorata) at Hoa My Reservoir between using fresh trash fish and industrial feed.

2. EXPERIMENTAL DESIGNING

2.1. Experimental cages

There are four floating cages with drilled holes Ø 1.5 cm, with size (3x 1.5x 1 meter each) and suspended on water surface because of plastic buoys. All cages have the period of the experiment with the same management practices at Hoa My reservoir in Phong Dien district, Hue province from October 5, 2010 to the end of February, 2012.

2.2. Feeding regime design

Giant eel is separated by two different feed, being called experiment A & experiment B. Each experiment is located at 2 floating cages, the growth performance of Giant eel is checked carefully because growth performance shows the time required by culturing fish from beginning to harvesting. At the end of this experiment, Giant eel will reach the standard size and sell to customers (Lamson et al. 2009). In this condition, the experimental cages A was fed by fresh trash fish; the experimental cages B was fed with industrial feed, being industrial

pellets used for the catfish diet with 45% protein, bought from Proconco Company which is located at Dong Nai Province, Vietnam.

Both experiments were fed by hand 1time /day.

- Fingerlings varieties between 104g / head - 122g / head (average 115.25 ± 6.98 g/head).
- Fingerling stocking density: 240 heads/cage.
- During this adaptation period, the changes of weight were recorded 1 time/ 2 months.

Scheduled time seems that a period of times from 10/05/2010 to 15/12/2010 prepares fingerlings due to fish from the wild water, this amount is small and then concentration. Harvesting is done after 16 months of culturing Giant eel at 05/02/2012. To regularly monitor the fluctuations of environmental parameters in order to maintain a good environment for the fish activities is dramatically essential because Giant eel may be affected by nematode as hysterothylacium recorded from eels of the family Anguillidae.(Moravec et al. 2012) The elvers of (the giant mottled eel) were infected with parasites (Vo et al. 2014).

2.3. Environmental management

In a physicochemical analysis of water elements, there are water temperature, pH and DO, measured using Mercury Thermometer (0.5), PH test of CP Company at Dong Nai Province, Vietnam, WalkLAB machine respectively, all are checked 2 times per day at 7.am and 2.pm. Each element gets an average of 15 days in the experimental time of culturing Giant eel.

2.4. Statistical analysis

Excel program is chosen for analyzing all finding data. Especially, the weight performance of Giant eel is analyzed by ANOVA method for testing the effects of the different feed on the fish status and whether significant ($p<0.05$) differences were found.

The costs for each material are fully recorded as a basis for evaluating the economic efficiency at the end of this research.

3. RESULTS AND DISCUSSION

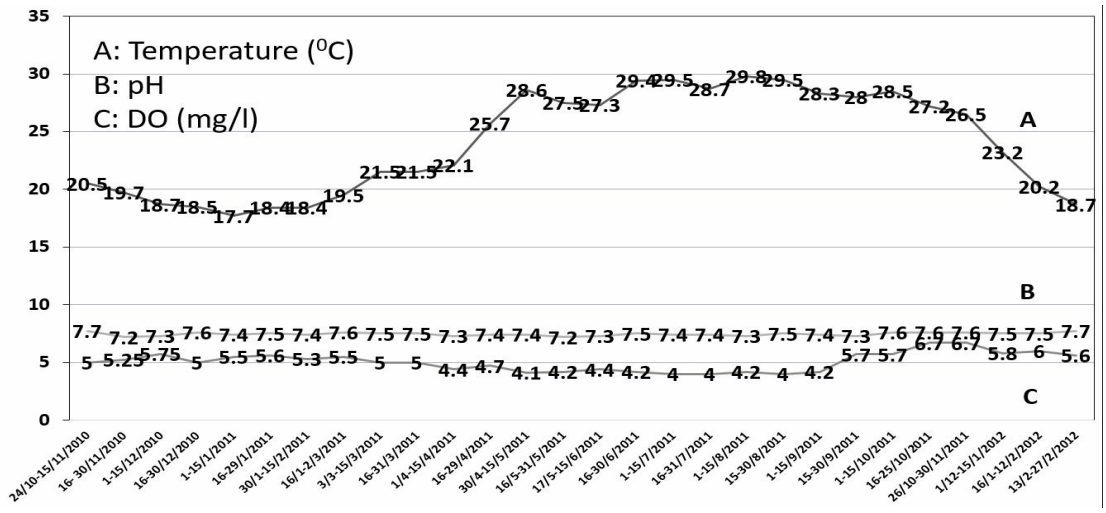

Figure 1. Temperature, DO, pH during experiment

Recorded values (Figure 1) showed suitable environmental conditions for rearing Giant eel in four cages at Hoa My reservoir. Firstly, values of pH are lowest at 6.8 and highest at 8.2, and average 7.5. The range of pH could be more suitable Giant eel culture for its optimum growth performance and survival rate, being compared with pH=7,8-9,0 (Hai and Phuong 2006). Secondly, figure 1 shows that there are the lowest and largest amounts of DO (4mg/l and 6.7 mg/l respectively). Dissolved oxygen levels (DO) during the study is in the threshold > 4 mg/l, which suggests that the density of fish in cages is not too large. If a level of DO is lower, the adverse effects occur through cage culture of Giant eel in a freshwater system. Therefore, basing on the level of pH and DO, Hoa My reservoir with a large amount of water

for agricultural irrigation activities is calculated as a potential freshwater area to develop Giant Eel (Anguilla Marmorata). Another factor affecting the growth of Giant eel is temperature. In Figure 1, the water temperature has a huge fluctuation between the months of the experimental period. The lowest average temperature is 17,7^{0}C in January 2011, and the highest average temperatures is 30 ^{0}C in August 2011. From November 2010 to March 2011, the water temperature is consistently below 20^{0}C. However, the biological characteristics of the Giant eel, the temperature fluctuations did not affect the growth performance of the fish. Determined by the experimental measurements at the beginning and end of the experiment, the environmental conditions such as DO, pH, and temperature effect on all of four cages, are the same. It means that the goal of this paper is kept for showing the effects of different feeds on the growth performance of Giant Eel.

Table 1. Effect of different feeds on Giant Eel's weight (gram)

Times	Fresh Trap Fishes	Industrial Feed
15/12/2010	118,25±9,24^a	117,95±5,93^a
15/2/2011	154,4±10,59^a	132,75±9,03^b
15/4/2011	227±13,9^a	152,75±9,59^b
15/6/2011	280,55±14,3^a	186±10,03^b
15/8/2011	408,1±28,08^a	239,95±12,4^b
15/10/2011	507,7±31,83^a	307,55±23,62^b
15/12/1011	659,45±31,82^a	392,5±15,64^b
13/2/2012	826,35±61,35^a	538,4±30,51^b

The growth performance of Giant eel is slow and then almost 16 months (Figure 2) and (Table 1) average weight of Giant eel is just over 826,3g / head (to gain weight being 700 g / head, experiment A) and more 538,4g / head (to gain weight being 400 g / head, experiment B). In both experiment, the growth rate of Giant eel in the early months is slow, comparison with the next months because this fish has not initially adapted to the new living conditions because of an afraid of noise and then they eat little. After adapting to the new living conditions, Giant eel grows faster and the growth characteristic of Giant eel is considered in an application process in a protection of offspring of the Giant eel (Yoshinaga et al. 2014) and a campaign of monitoring efforts and conservation strategies for freshwater fish populations as temperate and tropical Giant eel (Jacoby et al. 2015) and (Dekker et al. 2003).

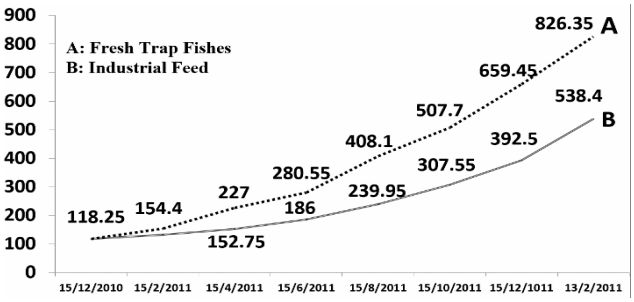

Figure 2. Effect of different feeds on Tilapia weight (gram)

A comparison between the two experiments fed by the fresh trash feed and industrial feed has a clear result. In the first period of time, the stocking of fingerlings completed and showing no difference in the growth rate of fish (P> 0.05). However, from inspection on Febuary15, 2011 (after more than 3 months of culture), the average weight of Giant eel farmed in the two treatments A & B had significant differences (P <0.05). Specifically, these fish fed with trash fish fresh have faster growth rate, reaching an average weight of 826.3 ± 61 g / head. And Giant eel fed by industry feed, reaching only 538.4 ± 30 g / head. So, the difference in average weight between 2 experiments A& B was 287.9 g / head. This difference indicates the industrial feed with high protein (45%), but it still does not meet the natural nutritional needs of the trash fish. As a result, to need more research about the nutrition of Giant eel is necessary to be able to rear this fish on the larger scale.

4. COST ANALYSIS

Table 2 & 3 illustrate that experiment A, the fish fed by fresh trash fish with costs, account for the largest proportion (almost 26 million VND), followed by the cost of fingerlings (over 20 million VND). Total cost for this treatment is over 59.4 million VND. Giant eel are fed by fresh trash fish, they grow fast with high price, after calculation, an income is 9.5 million VND. Experiment B of costs is less than the fresh trap fish, growth performance of fish is slow and

fish-products sold at low price, we do not get an income and even has loss of more than 17.500.000 VND. From the above analysis, using the fresh trap feed in rearing *Giant eel* has high economic efficiency than the industrial feed.

Table 2. Economic efficiency in using the fresh trash fish (VND)

No.	Items	Unit	number	Price (VND)	(VND)
1	Floating cage cost	1	2	6.000.000/ 2 year	3.000.000
2	Fish fingerlings cost	kg	55	370.000	20.424.000
3	Fresh trap fish cost	Kg	3.058	8.500	25.998.000
4	Cost of management, care and protection cage	Each cage	2	5.000.000	10.000.000
I- Total Purchases					59.422.000
II- Total Sales = a + b					68.396.000
a, Money from the fresh giant eels: 210,9 kg * 320.000,0VND/kg					67.488.000
b, Money from the dead giant eels					908.000
III- Income = Total Sales - Total Purchases					9.514.000

Table 3. Economic efficiency in using the industrial feed (VND)

No.	Items	Unit	number	Price (VND)	(VND)
1	Floating cage cost	1	2	6.000.000/ 2 year	3.000.000
2	Fish fingerlings cost	kg	55	370.000	20.424.000
3	Industrial feed cost	Kg	378	32.500	12.300.000
4	Cost of management, care and protection cage	Each cage	2	5.000.000	10.000.000
I- Total Purchases					42.724.000
II- Total Sales = a + b					25.088.000
a, Money from the fresh giant eels: : 84,2 kg * 290.000,0VND/kg					24.180.000
b, Money from the dead giant eels					908.000
III- Income = Total Sales - Total Purchases					-17.636.000

5. CONCLUSION

- Temperature, pH and dissolved oxygen levels at Hoa My reservoir are considered the good water elements for this research because these elements are in tolerance levels of Giant eel's growth.

- Culturing the Giant eel is difficult in finding fingerlings and testing a quality of fingerlings, it leads to the high mortality rate in the amount of fish, it may affect the experimental results. Overall, growth performance of Giant eel is acceptable. After 16 months, Giant eel with the fresh trash fish has an average weight 826.3 ± 61,3 g/head, higher than the industrial feed being 538.4 ± 30,5 g/head. Growth performance of Giant eel was reared by the fresh trash feed and the industrial feed has statistically significant differences ($P < 0.05$). In calculating of economic efficiency, results demonstrate that culturing Giant eel by using the fresh trash fish has an income around 9.5 million VND. Conversely, using industrial feed have already lost to over 17.5 million VND.

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Tóm tắt:

HIỆU SUẤT TĂNG TRƯỞNG CỦA CÁ CHÌNH (ANGUILLA MARMORATA) TẠI HỒ CHỨA HÒA MỸ, TỈNH THỪA THIÊN HUẾ, VIỆT NAM

Cá chình (Anguilla marmorata) được chọn cho nghiên cứu này với trọng lượng trung bình là 115,25 ± 6,98 g/con, thời gian thí nghiệm tín từ ngày 5 tháng 10 năm 2010 đến tháng 2 năm 2012

tại hồ Hòa Mỹ. Cá chình con này được nuôi trong 4 lồng nổi với lỗ khoan Ø 1,5 cm, với kích thước (3,0 x 1,5 x 1,0 m), treo nổi bằng phao nhựa và mật độ thả cá là 240 con/lồng và trong thời gian nuôi này, những thay đổi rọng lượng được ghi nhận 1 lần/2 tháng. Mục tiêu tìm thấy sự lựa chọn phù hợp sử dụng cá tạp tươi hoặc thức ăn công nghiệp để nuôi cá chình trong nước ngọt. Kết quả cho thấy hồ chứa Hòa Mỹ có tìm năng năng như độ ổn định pH (6,8-8,2), DO (4 - 6mg / l). Nhiệt độ dao động từ 17,7 ^{0}C - 30 ^{0}C nằm trong giới hạn nhiệt độ của cá chình, các yếu tố nhiệt độ này không ảnh hưởng đến hiệu suất tăng trưởng của chúng. Cá chình sử dụng cá tạp tươi đạt 826,35 ± 61,35 g/con, thu nhập 9.514.000 đồng (với giá 320.000 đồng /kg cá) và cá chình với thức ăn công nghiệp chỉ đạt trọng lượng 538.4 ± 30.51 g/con (với giá 290.000 đ/kg cá), thua lỗ đến 17.500.000 VND. Nghiên cứu này cho thấy nông dân nên sử dụng cá tạp tươi để nuôi giống cá chình này.
Từ khóa: Hồ Hòa Mỹ, cá chình, thức ăn, hiệu quả kinh tế.

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