Effect of Different Salinity Level within Water Against Growth Rate, Survival Rate (FCR) of Catfish (Clarias sp.)

D Prananingtyas1*, Prayogo2 and B S Rahardja3*

1Program Studi Budidaya Perairan, Fakultas Perikanan dan Kelautan Universitas Airlangga, Surabaya 60115
2Departemen Manajemen Kesehatan Ikan dan Budidaya Perairan, Fakultas Perikanan dan Kelautan Universitas Airlangga, Surabaya 60115
3dellaprana@yahoo.com

Abstract. Catfish (Clarias sp.) is a freshwater fish that is widely cultivated throughout Indonesia due to its importance and high market prospect. Some of the advantages of catfish include adequate nutrition, fast and easy growth. Salinity is one of the water quality parameters which directly affect fish body metabolism and osmoregulation. Increasing salinity may affect energy utilization within the osmoregulation process. Salinity is one of the environmental factors that can affect the rate of growth and feed consumption. This experiment was conducted to understand how salinized media may affect growth rate, survival rate and feed conversion ratio (FCR). The most optimal salinity that affects the aforementioned parameter was also observed. The research method used Randomized Complete Design with four treatments and five replications. Treatments were given code P0 (0ppt), P1 (3ppt), P2 (6ppt) and P3 (9ppt). Data analysis was done using ANOVA followed by Duncan Multiple Range test. Results indicated that salinity difference had significant effect (p<0.05) against growth rate, survival rate and FCR. Statistical analysis showed highest growth rate was on P3 (3.085 grams) and lowest was on P1 (1.572 grams). All survival rates showed similar value at 100%. FCR value was observed at lowest value on P3 (0.765) and highest was on P1 (1.572).

Keyword: Clarias sp., Salinity, growth rate, survival rate and feed conversion rate

1. Introduction
Catfish (Clarias sp.) is a freshwater fish that is widely cultivated almost throughout Indonesia. This is because catfish is an important commodity, and has good market prospect (Yunus et al., 2014). Some of the benefits of catfish are to have a fairly high nutritional content, economic value, rapid growth and easy maintenance (Prayogo et al., 2012).

West Java catfish seed demand on average reaches 800,000 individuals per day, and even has the potential demand to reach 1.5 million head per day. However, the production that can be done in the area reaches, on average, 600,000 individuals per day. Catfish is popular at all levels of society as an alternative animal protein. Catfish is easy to process, highly nutritious and tastes good. Catfish is easy to maintain, store and market in the form of live fish and fresh fish (Puspowardoyo and Djarijah, 2002).

One of the problems for catfish farmers is that not all regions have good freshwater resources. Coastal areas and small islands in the middle of the open seas are areas that are poor for
freshwater resources. Water resources in the region are generally of poor quality because the groundwater is salty or brackish (Arie et al., 1996). The ability to adapt an organism to be cultivated to environmental change is closely related to the success of the cultivation business. The ability of the organism to adjust to changes in temperature, salinity, dissolved oxygen, free carbon dioxide, nitrite content, ammonia, organic matter and water pH should be considered in cultivation (Widaningroewo and Isnansetyo, 1996).

Salinity is one of the water quality parameters that directly affect fish metabolism, especially the osmoregulation process. By providing salinity treatment it can improve the efficiency of energy used in the process of osmoregulation in catfish seeds, which can increase its growth. Other aspects of fish physiology influenced by salinity are osmotic pressure and body fluid concentration (Holliday, 1969). Feed with good quality and sustainable availability is needed for fish to grow and develop optimally. Millamena et al. (2002) stated that the quality of the feed is determined by the nutrients in it because the fish will efficiently utilize this to gain energy feed according to their needs.

2. Material and Methods
2.1. Place and time of research
Research was conducted at the Laboratory of the Faculty of Fisheries and Marine Resources, University of Airlangga. This study was conducted in April - May 2017.

2.2. Tools and Materials
2.2.1. Tools
The tools used in the study were the aquarium, as many as 20 pieces with a size of 40 x 20 x 25 cm³, aerators (Resun; Model AC-9904), aeration hose, aeration stone, analytical balance, refractometer, styrofoam, thermometer, DO meter, pH pen, test kit ammonia, fiber, measuring cup, beaker, label paper, ruler and pencil perpen.

2.2.2. Materials
The material used in this research is catfish seeds with size 7-9 cm from Group of Mina Usaha Cemeng Bakalan Sidoarjo, commercial feed PF-800 and sea water with salinity 30ppt obtained from Gunungsari fish market. There are four treatments and five replications, with an aquarium filled with 20 fish, so a total of 400 fish.

2.3. Work procedures
The aquarium was used as many as 20 pieces with size 40 x 20 x 25 cm³. Before use, the aquarium was cleaned and sterilized in advance to avoid disease. The equipment was washed with soap and rinsed and then chlorinated, rinsed and dried. The dried aquarium was filled with freshwater. After freshwater filling into the aquarium, then aeration was done for 24 hours to increase dissolved oxygen and to eliminate unwanted chemicals still in the aquarium. Acclimatization of catfish was conducted during the day.

Then the fish were fasted for one day to eliminate the effect of feed given earlier. The fish used in this study are catfish (Clarias sp.) Size 7 – 9cm, 3-5 grams, a healthy weight and not diseased. Fish seeds are stocked during low temperatures, in the morning or evening. Catfish were first acclimatized for one day.

Preparation of salinity medium used 30ppt salt water and sea water. Freshwater was used for treatment for water, stock media salinity 0ppt. Seawater dilution to obtain salinity media was water 3ppt, 6ppt and 9ppt. Freshwater was used for the treatment, first precipitated for a week to reduce the turbidity of water, while, to increase the dissolved oxygen content, freshwater was aerated. Before stocked, catfish seeds were acclimatized to salinity improvement for two days per 1ppt.

Catfish breeding was done for 30 days, filled with 20 individuals per aquarium. The feed used was pellet commercial feed with 36-41% protein content. During maintenance of catfish, they were fed pellets as many as three times a day, namely at 08:00, 12:00 and 16:00. Feeding used a restricted
During the maintenance, 20% of the total volume was used to dispose of fish feces and feed residues that contaminated the water in the aquarium. Syphoning was done for water quality on maintenance medium to be constant at optimal condition and not causing poison for the fish.

3. Parameters of Research
The main parameters in this study were growth rate, survival and feed conversion ratio, while the supporting parameters were water quality as regard pH, temperature, DO and ammonia.

4. Data analysis
Analysis of data used variant analysis (ANOVA) with the study design using completely randomized design (CRD) to determine any differences in treatment. If there was a difference in treatment, further test was carried out using Duncan's multiple range test (Kusriningrum, 2012).

5. Results
5.1. Growth rate
The research result of the growth rate of catfish for 30 days can be seen in Table 1. The results of ANOVA showed that the effect of salinity had significant difference (p <0.05) in the rate of catfish growth, so it was proceeded to Duncan Multiple Range Test.

From the results of Duncan's Multiple Range Test it can be seen that the highest growth rate was in treatment P3 (9ppt) with an average of 3.085 grams growth while growth in treatment P1 was lowest (3ppt) with average growth rate of 1.572 grams. The average growth rate values in catfish maintenance can be seen in Table 1.

| Treatment | Average GR Catfish ± SD (%) |
|-----------|----------------------------|
| P0        | 2.524 ± 0.108<sup>a</sup>  |
| P1        | 1.572 ± 0.598<sup>b</sup>  |
| P2        | 1.783 ± 0.696<sup>c</sup>  |
| P3        | 3.085 ± 0.500<sup>d</sup>  |

Description: P0 (Salinity 0ppt per Control), P1 (Salinity 3ppt), P2 (Salinity 6ppt), P3 (Salinity 9ppt)

The average growth rate of catfish for 30 days can be known as P0 treatment with average growth of 2.524 gram, P1 treatment with average growth of 1.572 gram, P2 treatment with average growth of 1.783 gram and treatment P3 with average growth of 3.085 grams. The highest growth rate was seen in P3 treatment and the lowest growth rate was seen in P1 treatment.

5.2. Survival rate
The results of the study of the survival of catfish during the 30-day maintenance period are 100%. The average survival data can be seen in Graph 1.
5.3. Feed Conversion Rate (FCR)
The research results of catfish feed conversion ratio for 30-day maintenance period can be seen in Table 2. The results of ANOVA showed that the effect of salinity show significant difference (p <0.05) on catfish feed conversion ratio, so it was proceeded to Duncan Multiple Range Test.

From the results of Duncan's Multiple Range Test it can be seen that the value of the lowest feed conversion ratio was in treatment P3 (9ppt) with the average value of the feed conversion ratio 0.765 and the highest feed conversion ratio was in treatment P1 (3ppt) with average of 0.891. Average feed conversion ratio values in the maintenance of catfish can be seen in Table 2.

Table 2. The mean value of feed conversion ratio of different treated catfish

| Treatment | Average Rate Conversion Feed Catfish ± SD (%) |
|-----------|-----------------------------------------------|
| P0        | 0.891 ± 0. 251a                                |
| P1        | 1.142± 0. 147b                                |
| P2        | 1.074 ± 0. 649c                               |
| P3        | 0.765 ± 0. 266c                               |

Description: P0 (Salinity 0ppt per Control), P1 (Salinity 3ppt), P2 (Salinity 6ppt), P3 (Salinity 9ppt)

The average yield of feed conversion ratio of catfish for 30 days can be known as treatment P0 with average feed conversion ratio 0.891, treatment P1 with average feed conversion ratio 1.142, treatment of P2 with average feed conversion ratio 1.074 and treatment of P3 with average feed conversion ratio 0.765. The lowest average feed conversion rate was seen in P3 treatment and the highest mean feed conversion rate was seen in P1 treatment.

5.4. Water quality

Water quality data on fish-breeding African catfish (Clarias sp.) can be seen in Table 3. The water quality parameters were observed during the study as temperature, pH, dissolved oxygen and ammonia.

Table 3. Data Range of Water Quality of Catfish During Maintenance

| Water quality | Treatment | Normal range |
|---------------|-----------|--------------|
|               | P0        | P1  | P2  | P3  |               |
| Temperature (°C) | 28-29 | 28-29 | 28-29 | 28-29 | 25-31 (°C)  |
| pH            | 6-7      | 6-7  | 6-7  | 6-7  | 6-9           |
| DO (mg L⁻¹)   | 4-5      | 4-5  | 4-5  | 4-5  | 5mg L⁻¹      |
| Ammonia       | 0.003    | 0.006 | 0.006 | 0.006 | <0.025mg L⁻¹ |

Description: P0 (Salinity 0ppt per Control), P1 (Salinity 3ppt), P2 (Salinity 6ppt), P3 (Salinity 9ppt)
6. Discussion

6.1. Growth rate
The rate of growth is the increase in length and weight in a given time (Yunus et al., 2014). According to Effendie (1997 cited in Zidni et al., 2013) fish growth will occur when there is excess energy from feed proteins needed for maintenance and body activities that are used for growth. Based on the results of statistical analysis of test data, different salinity can affect the catfish growth rate. In Table 1, it can be seen that the growth rate of catfish showed significantly different (p> 0.05) values between treatment P3 (9ppt) with treatment P0 (control). The rate of growth is highest in treatment P3 (9ppt). The content of salt in a medium salinity is closely related to the system (mechanism) osmoregulation in freshwater organisms. Affandi (2001) found aquatic organisms have an osmotic pressure that is different to their surroundings. This indicates the salinity as one of the parameters of water quality directly affecting the metabolism of the fish body. Fish tendency to be active may restore energy to feed and adjust the environment, also physiological processes in the body are able to work normally again (Holliday, 1969).

According to Zulhadiati et al. (2011), the salinity tolerance of catfish ranges from 0-6ppt. The salinity of catfish is applied to the research, which can reach 9-11ppt (Soelistyowati, 2013). The growth rate of catfish was lowest for treatment P1 (3ppt) and P2 (6ppt). This indicates that, according to Tine and Safrudin (1982 cited in Mutaqin, 2006) stress is a disturbance of homeostatic mechanisms and feed nutrients are not absorbed completely. Each organism has different osmoregulation abilities as a response to osmotic changes in its external environment. Changes in physiological activity may alter osmotic pressure settings by reducing the osmotic gradient between body fluids and the environment.

6.2. Survival rate
The survival rate (SR) is the number of fish that live up to the end of maintenance (Bactiar, 2006). Factors to note affecting the survival of catfish are stocking density, feeding, disease and water quality. Catfish can survive in a narrow pool with a high stocking density, but with certain limits, and the use of high quality feed for the nutritional needs of fish (Yuniarti, 2006).

Based on the results of statistical analysis of test data, different salinity has no effect on the survival of catfish because the fish were not dying on each treatment, as shown in Figure 1. It can be seen that the survival of the catfish showed a value of 100%. According to Muhammad (2006), catfish are stenohaline, which is the ability of any organism with a narrow degree of adaptation to high salinity. Seeds of fish have a great endurance, which means survival can be optimal and the absence of death (Mutaqin, 2006).

6.3. Feed Conversion Rate
Feed conversion ratio (FCR) is the ratio between the amount of feed consumed by the fish with the weight gain produced (Mukti, 2012). The composition balance in the diet can produce the maximum growth of fish (Andriani et al., 2007). Feed ingredients used can provide a good nutritional intake for fish.

Based on the results of statistical analysis of test data, different salinity can affect the feed conversion ratio (FCR) of catfish. In Table 2, it can be seen that the feed conversion ratio for catfish showed significantly different (p> 0.05) values between treatment P3 (9ppt) and treatment P0 (control), whereas in P2 (6ppt) and P1 (3ppt) there was no significant difference between treatments. Value of catfish feed conversion ratio was lowest for treatment P3 (9ppt). Salinity is needed by fish to regulate fluid balance that can stimulate the growth faster. Energy derived from food can be fully utilized to improve the fish growth, so that the physiological process runs normally. Fish can arrange osmotic pressure differently between the environment and body. This indicates that the low value of feed conversion will be better quality fish feed and the more efficient the use of feed consumed for growth, the greater the amount of energy produced (Mudjiman, 2002).
The highest feed conversion ratio was in P1 (3ppt) and P2 (6ppt) treatment; high feed conversion is also caused by the existence of undigested feed or less favored feed type, causing high ammonia value in the waters so that catfish cannot utilize feed well.

6.4. Water quality
According Gustav (1998 cited in Rukmana, 2003), the quality of the water plays an important role, especially in cultivation. Decrease in water quality can lead to death, stunted growth and the onset of pests.

Research supporting data in water quality included temperature, pH, dissolved oxygen content, ammonia and salinity. Measurements of water temperature were carried out daily during the study, ranging from 28-30°C. This shows that the water temperature range during the study is still in proper condition for the maintenance of catfish, which is 22-32°C (BBPBAT, 2005). An important factor that affects the growth and survival of fish in addition to feed is water quality, especially temperature. Temperature can affect important fish activities such as breathing, growth and reproduction. High temperatures can reduce dissolved oxygen and fish appetite (Kelabora, 2010).

Measurements of water pH values were performed daily during the study, ranging from 6-7. According to Boyd (1982), the optimal pH for the growth of most fish species ranged from 6.5 to 9.0. This shows that the pH value range is quite feasible for the maintenance of catfish seeds.

Measurements of DO (Dissolved oxygen) play an important role in the cultivation process; this is due to the fact that activity of microorganisms that perform the decomposition of organic matter requires enough oxygen. The result of measurement of dissolved oxygen content in catfish water maintenance ranged between 4-5mg L^{-1}. According to Boyd (1991), the dissolved oxygen content in the waters should be at least 3mg L^{-1} and optimum at 5mg L^{-1}. Fish need enough oxygen to survive in waters. This indicates that the range of DO values is quite feasible for the maintenance of catfish seeds.

Measurement of ammonia was done every three days by using a spectrophotometer or test kit. The results of ammonia measurements in the waters of catfish maintenance ranged from 0.003-0.006mg L^{-1}. According to Bhatnagar and Devi (2013), ammonia concentration optimum for the growth of catfish is <0.025mg per L. Concentrations of ammonia > 0.3mg L^{-1} will cause stress, decreased appetite, and fish mortality. It is necessary to do regular water changes to maintain the optimal value of ammonia (Pitrianingsih et al., 2014).

7. Conclusion
Based on the research that has been done, it can be concluded that the effect of different salinity (0ppt, 3ppt, 6ppt, 9ppt) can affect the growth rate, survival and feed conversion ratio of catfish. The result of the highest growth rate was found in treatment P3 (9ppt), which was 3.085 gram. The survival value result obtained at all treatments was 100%. The result of the lowest feed conversion ratio was found in P3 treatment (9ppt) of 0.765.

8. References
[1] Affandi, R and Tang, U.M. (2001). Fisiologi Hewan Air. Unri Press. Pekanbaru. 213 hal.
[2] Andriani Y, Haetami K and Susangka I. (2007). Kebutuhan dan pola makan ikan jambalsiam dari berbagai tingkat pemberian energi protein pakan dan pengaruhnya terhadap pertumbuhan dan efisiensi. PKM-P (ID): Universitas Padjajaran. 13 hal.
[3] Arie, H. N., Nusa, I. D., and Haryoto, I., (1996). Studi Kelayakan Teknis dan Ekonomis Unit Pengolahan Air Sistem Reverse Osmosis Kapasitas 500 m3 per hari untuk Perusahaan Minyak Lepas Pantai. 6 hal.
[4] Bactiar, Yusuf. (2006). Panduan Lengkap Budi dayaLele Dumbo. Agromedia. Jakarta. 102 hal.
[5] Balai Besar Pengembangan Budidaya Air Tawar (BBPBAT). (2005). Petunjuk Pembentihan Ikan Lele (Clarias sp.). Sukabumi. 6 hal.
[6] Bhatnagar A, Devi P. (2013). Water quality guidelines for the management of pond fish culture. *International Journal of Environmental Sciences*. 3(6): 1980-2009.

[7] Boyd, C. E. (1982). *Water Quality Management for Pond Fish Culture*. Amsterdam: Elsevier Scientific Publishing Company. 318 p.

[8] Boyd, C. E. (1991). *Water Quality Management in Ponds for Aquaculture*. Brimingham Publishing. Alabama.

[9] Gustav, F. (1988). Pengaruh Tingkat Kepadatan Terhadap Kelangsungan Hidup dan Pertumbuhan Benih Ikan Kakap putih (*Latescalcalifer*, Bloch) dalam Sistem Resirkulasi. Skripsi, Jurusan Budidaya Perairan, Fakultas Perikanan IPB. Bogor. 70 hal.

[10] Holliday, F.G.T. (1969). The Effect of Salinity on The Eggs and Larvae of Teleostei. Dalam: Hoar W.S. and Randall D.J. editor. *Fish Physiology*, vol. I. Academic Press, New York. hlm. 293-309.

[11] Kelabora, D.M. (2010). Pengaruh Suhu Terhadap Kelangsungan Hidup dan Pertumbuhan Larva Ikan Mas (*Cyprinuscarrpio*). Jurnal Berkala Perikanan Terubuk. 38(1): 71 – 81.

[12] Kusriningrum, R. S. (2012). *Buku Ajar Perancangan Percobaan*. Cetakan Keempat. Dani Abadi. Surabaya. hal 6-18.

[13] Mudjiman, A. (2002). *Makanan Ikan*. Penebar Swadaya. Jakarta. 190 hlm.

[14] Zulhadiati, Muntamah, Febby, Baehaki and Fajar. (2011). Pengaruh Salinitas Terhadap Perbaikan Kualitas Daging Ikan Lele Dumbo yang berbeda (PKM-P). Fakultas Perikanan dan Ilmu Kelautan (FPIK). Institut Pertanian Bogor. Bogor. 26 hal.
[26] Zidni, I., T. Herawati and E. Liviawy. 2013. Pengaruh Padat Tebar Terhadap Pertumbuhan Benih Lele Sangkuriang (Clariasgariepius) dalam Sistem Akuaponik. Fakultas Perikanan dan Ilmu Kelautan. Universitas Padjajaran. Bandung. 10 hal.

Acknowledgment
The author wishes to thank Prof. MirniLamid., MP. As the Dean of the Faculty who givesupport for this research. Tremendous appreciation goes to our friends Noviyanti Tri, EnggaWidiarto and Angga Puteri who helped us to set up the equipment for this research. Finally, to all civitas academics in the Faculty of Fisheries and Marine Universitas Airlangga who showed excellent and relentless effort to improve the institution.