Koi (Cyprinus carpio) Hatchery techniques: its performance in BBI Boyolali

M G Laksono¹, Sugianta², and M B Santanumurti³,⁴

¹Program Study of Aquaculture, Faculty of Fisheries and Marine, Universitas Airlangga, Kampus C Jalan Mulyorejo, Surabaya 60115 Jawa Timur, Indonesia.
²Balai Benih Ikan (BBI) Boyolali, Tlatar, Boyolali, Central Java, Indonesia.
³Department of Fish Health Management and Aquaculture, Faculty of Fisheries and Marine, Universitas Airlangga, Kampus C Jalan Mulyorejo, Surabaya 60115 East Java, Indonesia.
⁴Corresponding author: m.browijoyo.s@fpk.unair.ac.id

Abstract. One type of freshwater ornamental fish favored by the Indonesian community is koi (Cyprinus carpio). Therefore, koi hatchery conducted by farmers is increasing each year. This study reported the performance of koi hatchery activity at the Balai Benih Ikan (BBI), Boyolali, Central Java, which is known as one of the koi aquaculture sites in Indonesia. The working method used in this study was a descriptive method. The koi hatchery activities showed a fecundity of 420,000 eggs with a hatching rate of 85.71%. The spawned eggs hatch within 3-5 days after the spawning process. Growth sampling on larvae was carried out 4 times during the hatchery period. The larvae on day 21 have an average length of 2.78 cm while on day 28 had an average length of 3.32 cm while the survival rate reached 75%.

1. Introduction
Indonesia is a tropical country that holds a lot of biodiversity, including freshwater ornamental fish diversity. Ornamental fish is a fishery commodity that is in great demand by various society levels for both domestic and foreign markets. Since 2011, Indonesia's ornamental fish exports have ranked 5th in the world with total exports reaching US$ 5.24 million [1].

One type of freshwater ornamental fish favored by the community is koi (Cyprinus carpio). Koi itself has advantages, such as good shape, beautiful vivid color, high price, and adaptive to the environment so many people culture it [2], [3]. One of the activities in koi aquaculture is the hatchery.

The hatchery is an activity in aquaculture that greatly determines the next stage of activity and is aimed at producing seeds and the resulting seeds become an input component for enlargement activities [4]. The demand for koi seeds has yet to be fulfilled by fish seed producers because their production is relatively limited. Therefore, it is necessary to have a hatchery technology that is cheap and easy to apply by fish farmers which will encourage the production of quality hatcheries and ensure the continuity of seed supply according to demand [5]. One of the centers that carry out hatchery activities is the Boyolali Fish Seed Center or Balai Benih Ikan (BBI) Boyolali. BBI Boyolali is one of the centers that has been successful in conducting koi hatcheries. This study aimed to know how the koi hatchery technique activity at BBI Boyolali and determine its performance. The performance was seen from the fecundity, hatching rate, and survival rate. This research was expected to be additional information about koi hatchery.

2. Material and methods

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd
2.1. Sample preparation
Broodstock male and female koi used in this study were aged 1-2 years from Boyolali Fish Seed Center. The broodstock used follows the requirements in previous studies [6]. The broodstock characteristics are good morphology, bright, and healthy skin. The breeding was used traditional method with a male and female ratio of 3:2.

2.2. Sampling and performance calculation
The working method used in this study is a descriptive method, which is a method of examining the status of a group of people, an object, a condition, a system of thought, or a class of events at present to make a description [7]. The parameters measured were fecundity, hatching rate, and survival rate. The calculation of fecundity was done with the following formula [8]:

\[
\text{Fecundity} = \frac{\text{Egg numbers in media}}{\text{Total media}} \times \text{Medium area}
\]

Hatching rate (HR) calculation was done with the following formula [9]:

\[
\text{Hatching rate} = \frac{\text{Total of hatched eggs}}{\text{Total fertilized eggs}} \times 100\%
\]

The calculation of the survival rate (SR) was done with the following formula [10]:

\[
\text{SR} = \frac{N_0 - N_t}{N_0} \times 100\%
\]

Description: SR = Survival rate (%) Nt = Total fish died during experiment N0 = Total fish at the start of experiment

3. Result and discussion
3.1. Koi fecundity and hatching rate
Koi hatchery activities at the Tlatar Fish Seed Center resulted in fecundity of 420,000. This value was greater than previous studies which could only produce a maximum of 300,000 eggs [11]. The spawned eggs hatch within 3-5 days after the spawning process. The hatching rate value in BBI Boyolali could be seen in Figure 1. The calculation of the hatching rate of koi eggs was 85.71%. This value was better than the previous research which was only 29.33%-34.33% [12].

![Figure 1. Hatching rate of hatchery activity in BBI Boyolali](image)

The high rate of fecundity and hatching rate was due to the use of the correct male-female ratio for breeding. This was because previous studies only used a 2: 1 ratio [11] while the others used 1:1, 1:2, and 1:3 [12]. The male-female ratio must be precise for sufficient sperm to fertilize females [13]. In the hatchery activity at BBI Boyolali, the substrate used was *Hydrilla* sp. for sticking koi eggs. The use of...
Hydrilla sp. also affected the increase in fecundity and hatching rate. Another study stated that the use of Hydrilla sp. would increase fecundity and hatching of eggs because Hydrilla sp. could maintain water quality, especially oxygen in water [14].

3.2. Koi growth and survival rate
The growth of koi in BBI Boyolali showed in Table 1. Growth sampling on larvae was carried out 4 times during the hatchery period. The larvae on day 21 had an average length of 2.78 cm while on day 28 had an average length of 3.32 cm. This was lower than other studies showed that in 12 days it could reach 1.5 cm so that it would reach 3 cm in 24 days [15].

| Fish sample | 21 days | 28 days |
|-------------|---------|---------|
| 1           | 2.5 cm  | 3.4     |
| 2           | 2.9 cm  | 3.0     |
| 3           | 2.7 cm  | 3.1     |
| 4           | 2.5 cm  | 3.2     |
| 5           | 3.1 cm  | 2.9     |
| 6           | 2.8 cm  | 3.3     |
| 7           | 2.7 cm  | 3.5     |
| 8           | 3.1 cm  | 3.2     |
| 9           | 2.9 cm  | 3.4     |
| 10          | 2.6 cm  | 3.2     |
| Total       | 27.8 cm | 32.2    |
| Average     | 2.78 cm | 3.22    |

The results of the survival rate of koi in BBI Boyolali could be seen in Figure 2.

Figure 2. Survival rate of hatchery activity in BBI Boyolali

The survival rate was lower than other studies which reached 100% [16]. The low growth and survival rate at BBI Boyolali were due to insufficient nutritional intake for larvae. The adequate nutrient intake would increase the survival rate and growth of fish [17]. At BBI Boyolali, larvae after 2 days of age were fed Daphnia sp. and pelleted. Supposedly to increase the survival rate and growth rate it is necessary to enrich feed or give hormones [16], [18].

4. Conclusion
Koi hatchery activities there showed a fecundity of 420,000 eggs with a hatching rate of 85.71%. The spawned eggs hatch within 3-5 days after the spawning process. Growth sampling on larvae was carried
out 4 times during the hatchery period. The larvae on day 21 have an average length of 2.78 cm while on day 28 had an average length of 3.32 cm while the survival rate reached 75%.

5. References
[1] Khoironi F E, Saskara I A N 2017 *E J. EP Universitas Udayana* 6 337-361.
[2] Lahay A F, Maharsi G, Sudarno S 2013 *J. Aquac. Fish Health* 2 10-14.
[3] Kurnia A, Nur I, Muskita W H, Hamzah M, Iba W, Patadjai R S, Balubi A M, Kalidupa N 2019 *AACL* 12 1045-1053.
[4] Akbarurrasyid M, Nurazizah S, Rohman F S 2020 *J. Aquac. Fish Health* 9 30-37.
[5] Mustika R, Sofia L A, Agusliani E, Muhammad M 2020 *Jur. Sos. Ekonom. Kelautan Perikanan* 15 83-92.
[6] Laila K, Purwasih J 2020 *Jurn. Pionir* 6 319-228.
[7] Tajudin S, Hamzah A 2019 *J. Sosial Ekonomi Perikanan* 4 137-143.
[8] Tanbıyaskur, Muslim 2015 Teknologi Pemijahan Ikan dengan Cara Buatan (Induce Breeding) (Indralaya: Fakultas Petanian Universitas Sriwijaya).
[9] Amornsakun, T, Vo V H, Petchsupa N, Pau T M, bin Hassan A 2017 *SJST* 39 137-142.
[10] Putri T A, Maya S, Santanumurti M B 2020 *E&ES* 441 012052.
[11] Al Ishaqi A M, Sari P D W 2019 *Jurn. Perikanan dan Kelautan* 9 216-224.
[12] Kusriti E, Cindelaras S, Prasetio A B 2015 *Media Akuakultur* 10 71-78.
[13] Umar A, Hasniah H, Wahidah W 2018 *Pros. Sem. Nas. Sinergitas Multidis. Ilmu Pengetahuan Teknol.* 1 125-130.
[14] Sinjal H J 2011 *Jurn. Perikanan Kelautan Trop.* 7 32-35.
[15] Ambarwati N A, Damayanti R A, Hanifah N 2020 *Pros. Sem. Nas. MIPA Kolaborasi* 2 165-170.
[16] Sutiana S, Erlangga E, Zulfikar Z 2017 *Acta Aquatica: Aquatic Sciences Journal* 4 76-82.
[17] Taipale S J, Kahilainen K K, Holtgrieve G W, Peltomaa E T 2018 *Ecol. Evol.* 8 2671-2687.
[18] Subamia I W, Meilisza N, Permana A 2016 *Jurn. Riset Akuakultur* 8 429-438.

6. Acknowledgement
The authors gracefully acknowledge the collaboration from the Universitas Airlangga and BBI Boyolali.