

An Evaluation of Artificial Fish Nest for Assessment Enhancement Effects of Fishery Resources of in Xiangjiang River

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Abstract

Artificial fish nests are set in Lukou section and Hengyang section of Xiangjiang River from March 20 to May 10, 2019. The structure of artificial fish nest is bamboo frame, with the size of $2.5\text{ m} \times 5.0\text{ m} \times 4$ and a unit frame area of 60 m^2 . A total of 58,201 eggs were collected by 24 monitoring times, of which 30,441 were from Lukou and 27,760 from Hengyang. 3831 fish eggs identify 8 fish species using morphological or molecular biological methods. The results showed that the number of eggs peaked from the 8th day to the 24th day after the nest entered the water, and then decreased rapidly. There was significant negative correlation between egg number in per m^2 fish nest and days of fish nest ($P < 0.01$). The economic benefits of artificial fish nests were RMB 11.81 million. The artificial fish nest can not only increase the population of fish, but also has significant economic benefits.

Keywords

Artificial Fish Nest, Enhancement Effects of Fishery Resources, Xiangjiang River

1. Introduction

With the rapid development of the society, water conservancy and hydropower projects, dredging and shipping, environmental pollution has more and more significant impact on the water environment (Xie, 2017), leading to the gradual depletion of aquatic biological resources. It has become an urgent and important task to carry out artificial fish proliferation and environmental restoration (Luo et al., 2011; Liao et al., 2002; Liao et al., 2016). The artificial fish nest can provide a bed for the production of slimy eggs, which is a convenient, economic and ef-

fective way of artificial proliferation (Becker & Suthers, 2014; Nagayama & Nakamura, 2010; Li et al., 2018). In this study, evaluation of artificial fish nest for assessment enhancement effects of fishery resources in Xiangjiang River.

2. Materials and Methods

2.1. Study Area and Time

Artificial fish nests are set in Lukou section and Hengyang section of Xiangjiang River from March 20 to May 10, 2019 (Table 1). The setting area has the following characteristics: the water level is deep, the water flow is less than 0.2 m/s, and there is water grass growing along the coast, which leads to the lack of spawning place for the sticky egg fish.

2.2. Structure and Setting Mode of Artificial Fish Nest

The structure of artificial fish nest is bamboo frame (Figure 1), with the size of $2.5\text{ m} \times 5.0\text{ m} \times 4$ and a unit frame area of 60 m^2 . The buoyancy is adjusted by Gabions and floats to make the surface fish nests float on the water. The edge of the bamboo frame is tied with a cable, and the other end of the cable is tied with an anchor stone. The spacing between fixing rods is 40 cm. 3 - 5 pieces brown pieces were binded on the fixed rod every 30 cm (Liao et al., 2015).

2.3. Sampling Methods Data Analyses

Since the setting of artificial fish nest, each unit shall be inspected, maintained, observed, recorded and sampled at 8:00 a.m. every fourth day. A $10\text{ cm} \times 10\text{ cm}$

Table 1. Location, time and area of artificial fish nest in Xiangjiang River in 2019.

Setting location	Latitude and longitude	Time	Area (m^2)
Lukou	E113.138995; N27.588719	March 20 to May 10	4200
Hengyang	E112.620019; N26.889092	March 20 to May 10	5600
Total			9800



Figure 1. Photograph of artificial fish nest, taken on 10 March 2019.

square floating frame is used to randomly cast and select samples in the fish nest area. Six samples are selected for six units to calculate the spawning amount and fertilization rate per unit area. According to the different developmental stages, the production batches were separated and the species of eggs were identified by morphological or molecular biological methods.

3. Results

A total of 58,201 eggs were collected by 24 monitoring times, of which 30,441 were from Lukou and 27,760 from Hengyang (Table 2). The average number of fish eggs collected in Lukou and in Hengyang was 3636 eggs and 3521 eggs, separately.

3831 fish eggs identify 8 fish species using morphological or molecular biological methods (Figure 2). The top three percentages of catches are *Carassius auratus* (46.4%), *Cyprinus carpio* (33.8%), and *Hemiculter leuciclus* (8.1%).

The results showed that the number of eggs peaked from the 8th day to the 24th day after the nest entered the water, and then decreased rapidly (Figure 3). There was significant negative correlation between egg number in per m² fish nest and days of fish nest ($P < 0.01$). According to Calculation method for economic

Table 2. Statistics of eggs adhered to artificial nests.

Days of fishes nest in water		4	8	12	16	20	24	28	32	36	40	44	48	Total
Number of sample (eggs)	Lukou	0	22	4408	16,833	7810	649	308	210	133	55	9	4	30,441
	Hengyang	0	30	9040	11,509	5611	255	260	586	241	217	7	4	27,760
	Total													58,201
Average density (eggs/m ²)	Lukou	0	92	18367	70,138	32,542	2704	1283	875	554	229	38	17	126,838
	Hengyang	0	125	37667	47,954	23,379	1063	1083	2442	1004	904	29	17	115,667
Increase the quantity of fishery resources (10 ⁴ eggs)	Lukou	0	39	7714	29,458	13,668	1136	539	368	233	96	16	7	53,272
	Hengyang	0	70	21,093	26,854	13,092	595	607	1367	562	506	16	9	64,773

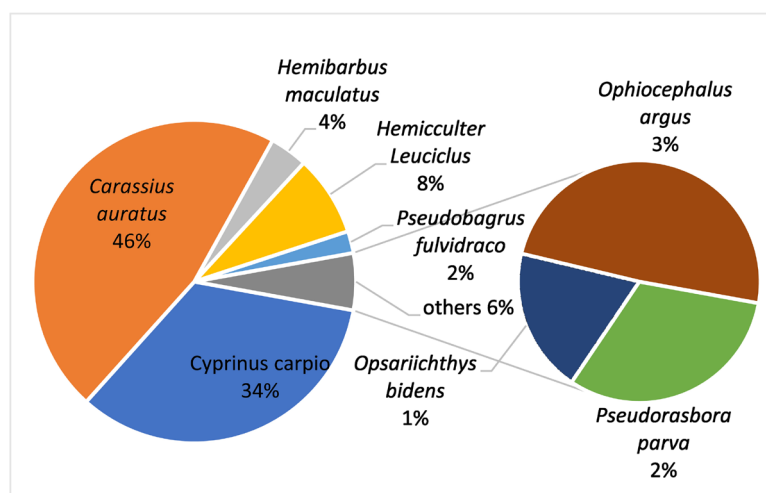


Figure 2. The percentages of catches.

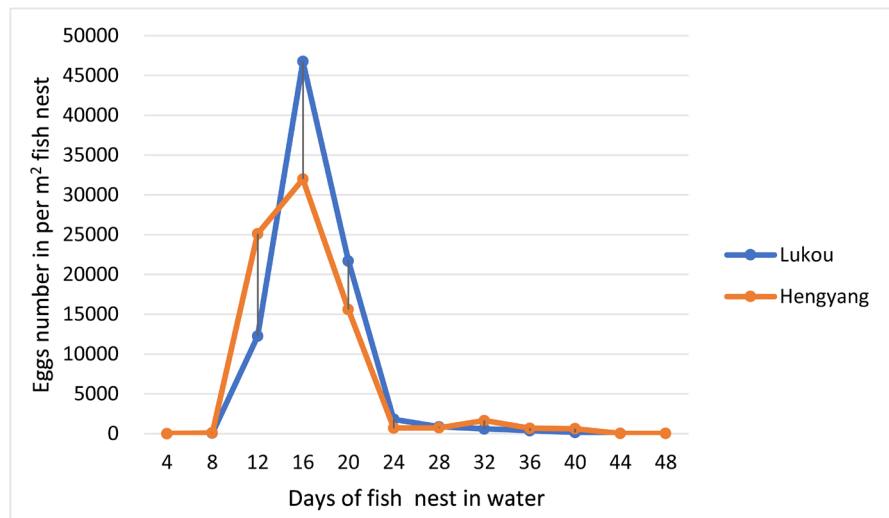


Figure 3. Correlation between eggs number in per m² fish nest and days of fish nest in water.

loss of fishery pollution accidents (Chen et al., 2018), we analyze that the economic benefits of artificial fish nests were RMB 11.81 million. Input output ratio is 8.6.

4. Discussion

Eight species of fish, such as carp and crucian carp, have been bred; the quantity was $118,045 \times 10^4$ eggs, by setting artificial fish nests in Xiangjiang River. Artificial artificial fish nest has the following advantages to breed the original resources of the river section; the parent background is clear, and the original state of population genes is preserved. Thus, the risk of artificial propagation and release is avoided. For example, the parental source of multiplying and releasing fish may be uncertain, which will lead to the germplasm resources degradation (Jiang & He, 2008).

The spawning period of stickiness is generally from March to May. In order to ensure the spawning effect of artificial fish nests, they should be cleaned regularly (Zhou et al., 2019; Wang et al., 2018). The results showed that the number of eggs peaked from the 8th day to the 24th day after the nest entered the water, and then decreased rapidly. In order to reduce the management cost, we suggest that the artificial fish nest should be set from March 20 to the end of April.

We analyze that the economic benefits of artificial fish nests were RMB 11.81 million. Input-output ratio is 8.6. More than 2000 artificial fish nests were put into Xijiang River (Peng et al., 2016), which can increase the economic benefits of fishing by 12.00 million yuan. The artificial fish nest can not only increase the population of fish, but also has significant economic benefits. It is suggested that the restoration of degraded fish habitat is a long-term task, which needs effective financial investment and technical support. However, cultural and statistical factors restrict its development. There is still a large space for the research and

application of artificial fish nests.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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