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Controlled Reproduction and Broodstock Rearing of the Chinese Sucker *Myxocyprinus asiaticus*

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Abstract

Intraperitoneal injections of luteinizing hormone-releasing hormone analogue (LRH-A), human chorionic gonadotropin (HCG) and domperidone (DOM) were used to induce spawning in the Chinese sucker, *Myxocyprinus asiaticus*. Both mature females and males, captured below the Gezhouba Dam in the mainstream of the Yangtze River, China, and artificially reared in a pond, were induce spawned successfully, but response time was longer and the hormone dosages used were higher, for example when compared to major Chinese carps.

Introduction

The Chinese sucker (*Myxocyprinus asiaticus*, Catostomidae) is an endangered species endemic to China, and is classified as a second-rate protected animal by the Chinese government. The family Catostomidae includes 61 species (Moyle and Cech 1988), of which most are found in North America. There are only two species in Asia; of these *Catostomus catostomus* is distributed in Siberia and shared with North America. The Chinese sucker is unique to China and is presently found only in the Yangtze River system. Moreover, fingerlings are highly priced in the ornamental fish trade, and artificial propagation of the species will enable the ornamental trade to be independent of the already depleted natural stocks.

During the last 20 years, the construction of the Gezhouba Dam on the Yangtze River in Yichang, Hubei Province, has impeded the reproductive migration path of many fish species. Fish populations have declined dramatically (Liu et al. 1995).

In recent years, attempts have been made to artificially propagate the Chinese sucker (Yu et al. 1988; Li 1991). The species has been reared from fry to

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advanced fingerling and beyond (Liu et al. 1990; Deng et al. 1991; Chen et al. 1992). However, no detailed reports on the technique of controlled reproduction and broodstock rearing of the species are available.

Materials and Methods

The study was carried out from March 1989 to May 1995 in Yichang, China. Mature females and males were captured below the Gezhouba Dam in the mainstream of the Yangtze River, and transported to the hatchery. Another group was reared from adult or spawned fish captured below the dam. In the hatchery, all broodstock were held in a 20 m^2, 1.5-m deep oval concrete tank with a water flow rate of about 60 $l \cdot min^{-1}$. Water temperature in the holding tank was 13-18°C, and dissolved oxygen concentrations 6.9-10.8 $mg \cdot l^{-1}$. Intraperitoneal injections of luteinizing hormone-releasing hormone analogue (LRH-A), human chorionic gonadotropin (HCG) and domperidone (DOM) were used to induce spawning. Eggs were collected, sperm was added and stirred for about 2 minutes to ensure fertilization, then eggs were washed three to six times with clean water to remove excess milt and avoid adhesion of eggs.

For the second group, all adult and spawned fish were reared in 300 m^2, 1.5-m deep rectangular concrete tanks. Water was obtained from the Huangbo River, a small branch of the Yangtze River. About one half of the tank was sheltered after 1992, and 5-20% of water was replenished daily. Water temperature in the rearing tanks was 8-34°C, and dissolved oxygen concentrations 5.2-11.9 $mg \cdot l^{-1}$. Prior to rearing, all fish were measured and tagged. The fish were fed with terrestrial and aquatic earthworms in 1989-92, and only aquatic earthworms in 1993-95. Feeding rates were 1-5% body weight per day according to temperature fluctuations.

Results

Controlled Reproduction of Broodstock Captured from the River

The individual body weights of nine mature females and six mature males captured from below the Gezhouba Dam ranged from 10.5 to 16.5 kg. The females were stripped and spawned successfully after injection, but dosages and injection times differed among individuals (Table 1). Fish no. 8903, 8904 and 9203 spawned when captured and only LRH-A was injected. The dosage was 0.05-0.1 $mg \cdot kg^{-1}$ body weight, and was injected only once; response time (the period from hormone injection to the time when the fish is ready to spawn) was 2-3 h. The response time of other females was 20-180 h and required higher dosages of the hormone. Mature males, however, released milt easily after injection with lower dosages (Table 1).

Table 1. Hormone dosage (mg·kg^{-1} body weight), injection times and response time for induce spawning of the Chinese sucker.

Fish no.	Sex	Hormone dosage			No. of times injected	Response time (h)
		LRH-A (mg)	HCG (IU)	DOM (mg)		
8901	M	0.02			1	0
8902	M	0.02			1	0
8903	F	0.05			1	3
8904	F	0.10			1	2
8905	F	0.27			2	24
9101	M	0.05			1	10
9102	M	0.10		2.5	4	48
9103	F	0.23	1,300	3.6	8	140
9201	F	0.18	800	3.5	8	162
9202	F	0.15	600		2	20
9203	F	0.05			1	2
9204	M	0.05			2	24
9301	F	0.15	500	3.2	5	46
9302	M	0.05			2	24
9303	F	0.25	1,200	3.8	10	180

Controlled Reproduction of Artificially Reared Broodstock

From 1993 to 1995, 12 females and seven males were artificially reared to sexual maturity. In 1993, fish no. 8901-8904 and 9203 were induced to spawn. For females, the dosage per kilogram of body weight was 0.25-0.3 mg LRH-A, 800-1,500 IU HCG and 3-5 mg DOM, and had to be injected 10-12 times. Response time was 140-180 h. For males, the dosage per kilogram of body weight was 0.05-0.1 mg LRH-A, 1-2 mg DOM, and had to be injected twice. Response time was 30-48 h. The eggs were fertilized but most of the embryos did not develop. Some fry hatched and survived 15-20 d. Mortality may have been due to non-inflation of the swim bladder.

In 1994-95, fish no. 8901-8904 and 9203 were reared to sexual maturity in addition to the seven females and five males reared to maturity for the first time. All fish were induce spawned with the same or with slightly higher dosages as in 1993. Eggs were fertilized and developed normally. A higher proportion of large fingerlings were obtained.

Embryonic Development

The rate of embryonic development of the Chinese sucker was correlated to water temperature. At 12.5-14.5°C, hatching time was 240 h; at 17.5-18.5°C, hatching time was 160 h; and at 21.0-23.0°C, it was only 115 h (Table 2). There

Table 2. Cumulative temperature-hours for the embryonic development of the Chinese sucker.

Temperature (°C)		Hatching time (h)	Cumulative temperature
Average	Range		
13.2	12.5-14.5	240	3168
18.0	17.5-18.5	160	2880
22.0	21.0-23.0	115	2530

was a significant difference in hatching time at different water temperatures ($P<0.01$). However, embryonic development in temperature hours did not differ between different treatments ($P>0.01$).

Secondary Sexual Characteristics of the Broodstock

During rearing of the broodstock, significant changes in coloration were observed. In October, broodstock gradually turned orange-yellow from grey-brown. The color change was more marked in males than in females. Males also had small tubercles on their anal and caudal fins, and head. By December, the color of both males and females turned brighter. Males had more tubercles than females. The following April, males turned a very bright orange-red. Tubercles were larger and greater in number. Females were grey-brown to orange-red, and had tubercles on the anal and caudal fins and head.

Discussion

Both mature female and male Chinese suckers can be induced to spawn successfully, but response time is longer and the hormone dosage needed is higher than reported for major Chinese carps (Liu and He 1992) and buffalo (Galasun et al. 1984). The Chinese sucker spawns at 13-18°C, a temperature much lower than that for Chinese carps (Liu and He 1992). It may be that the low temperature delays response time and the fish are able to tolerate a higher dosage of hormone. There were significant differences in response time and dosage among individuals; this could have been due to differences in maturity.

Some artificially reared broodstock were induce spawned in 1993. This was the first time that fish captured from below the Gezhouba Dam in the mainstream of the Yangtze River have been successfully reared to sexual maturity. Though fertilization rate was over 90%, most of the embryos did not develop fully. Egg diameter was 2.0-2.6 mm, similar to that of fish captured from the river ($P>0.05$), but the color was lighter. From April to August in 1992, fish were fed terrestrial earthworms. But the fish disliked the food, resulting in slow, and even negative growth. This may have affected ovarian development. Besides, water temperature in the pond in summer was 34°C, much higher than in the Yangtze River (<26°C), the natural habitat of the Chinese sucker. The high temperature may also have affected ovarian development, though the fish were able to tolerate it. From 1993 onwards, broodstock were fed only aquatic

earthworms and about one half of the pond was sheltered. The maximum water temperature in summer was 30°C. The fish grew well and all the broodstock spawned. Low temperature also results in fungal infection of eggs. Therefore, it is important to treat eggs with malachite green or formalin before hatching (Liu et al. 1995).

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