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Maturation and Reproduction of African Catfish in Recirculated System in Uzbekistan Environments

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Summary: Mature females and males of African catfish (Clarias gariepinus) were overwintered, artificial reproduction using gonadotropic injections was carried out, eggs were incubated, larvae were reared from January to mid-April 2022 in closed conditions of a recirculated aquaculture system with a water temperature of 18-25 ° C. In April, fingerlings were transplanted into cages in the Tuyabuguz reservoir. By the end of October, catfish reached a body weight of 1.1 - 3.4 kg.

Keywords: Aquaculture, African catfish, Clarias gariepinus, artificial fish reproduction, Uzbekistan.

Introduction

Pond carp farming is the main mass technology for fish production in Uzbekistan (Kamilov, Kurbanov, 2003); in the last decade, it has increased production to more than 100 thousand tons per year, occupying all available land in the irrigated farming zone. However, Uzbekistan needs a further manifold increase in fish production; pond carp farming can no longer provide this. It also cannot ensure the integrated use of water resources, because is the target water user. The republic needs additional development of so-called methods. industrial fish farming and expanding the list of cultivated objects, because pond fish farming objects are not objectively suitable for this purpose due to their biological characteristics). In recent years, African catfish (Clarias gariepinus) has been widely introduced into the republic - this is an omnivorous, bottom-dwelling tropical fish species, highly plastic, resistant to dissolved oxygen deficiency, for which breeding characteristics are known for many tropical regions. The species is distributed throughout Africa and is found in the Middle East and southern Turkey (Hogendoorn, 1979; 1980; De Graaf et al, 1996; Yalçin et al, 2001). The species was brought to Uzbekistan in two small batches from the Netherlands in the mid-2010s, the republic mastered its artificial reproduction in open conditions (in May), and bred in pools, cages, and ponds in industrial fish farming conditions, mainly in two years. That. fish farms grow home-grown fish. For further development of catfish cultivation, it is necessary to study in detail the features of its maturation and reproduction, incl. in conditions of closed water supply installations (RAS). The purpose of this study was to study the characteristics of the reproductive function of African catfish under RAS conditions in Uzbekistan.

Material and methodology

The work was carried out in 2022 in an aquarium workshop; 10 mature fish of both sexes were kept in three plastic pools (1 m3 each), where the temperature was maintained at 22-26 oC from October to April. The fish stocking density was 5-7 kg/m3. The fish were kept separately by sex. Each pool was equipped with an external filter (mechanical and biological, Attman). At the beginning of January, pituitary injections were carried out with acetonated carp pituitary glands: the injection dose was 4 mg/kg fish body weight. The caviar was filtered out from itself. The males were killed, dissected vertically, and the milt was squeezed out of the testes onto the eggs. We carried out artificial insemination and de-gluing of eggs. The eggs were incubated in a Weiss apparatus. In each batch, 20 random eggs and 20 larvae were selected and fixed in a 4% formaldehyde solution. Using a microfilm reader “Mikrofot – 5 PO – 1”, the diameter of the eggs and the body length of the larvae were measured.

After hatching, the larvae were placed in plastic tanks until mid-April. The average daily water temperature during this period was in the range of 18.5 – 28.2 oC. The dissolved oxygen concentration was above 3.5 mg/L throughout the period. The larvae were fed starter feeds. In April, when the water temperature in cages installed at the Tuyabuguz reservoir (Tashkent region) exceeded 18 ° C, the fry, which reached an

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average of 22.4 g, were transplanted into cages with a volume of 1 m3, where they were fed with food for African catfish "Coppens". The fish were kept at a stocking density of about 20 kg/m3. To do this, every 20-25 days the fish were transplanted and sorted by size (so that there were catfish of the same size in the cage); a total of 3 transplants were done during the growing season. Water temperatures in the reservoir were favorable for African catfish until the end of October.

Every month, without choice, 5-10 individuals were analyzed, their body weight and body length were measured, dissected, and the sex and stage of gonad maturity were determined visually according to a 5-point scheme of maturity stages (Pravdin, 1966). A piece from the middle of the gonads was fixed in a 4% formalin solution. In laboratory conditions, a histological preparation was prepared with sections 5-6 mm thick, stained with iron hematoxylin according to Heidenhain. On sections, the stage of the most developed oocytes was determined using a light microscope according to Makeeva (Makeeva, 1992).

Results. In our sample there were 2 females weighing 1400 and 1900 g and two males weighing 1300 and 1305 g. Fish of both sexes clearly showed signs of sexual maturity: females had a soft, rounded abdomen and an inflamed genital opening, while males had a well-developed papilla. After injection (January 7) (4 mg/kg body weight of fish), the fish in pairs (male and female) were placed in a separate pool. After 14 hours, the males began to attack the females (pounce on her), which indicated spawning behavior.

The males were dissected, the testes were removed, and they were crushed in halves of Petri dishes to obtain sperm. The eggs of the females were strained. The average diameter of ovulated eggs was 0.15 mm. The working fertility of females was 150 and 220 g. Artificial insemination was carried out. De-sticking was carried out with milk. The eggs were placed in two Weiss apparatuses. An analysis of the development of eggs in the apparatus showed that the fertilization percentage was 79 and 85%, and the yield of larvae was 65 and 71%. The hatched larvae had a body length of 4.2 – 4.5 mm.

After 3 days, they started giving starter food, and in the first weeks the fish were fed until they were full. From February 7, they began to feed according to rations, adjusted in accordance with the recommendations of the manufacturer (according to water temperature and fish size). By February 20, the fish had reached the fry stage (1.6 – 4.2 g).

By mid-April, the fish reached the size of the fish seed (20 - 31 g, on average - 22.4 g). They were transported in plastic bags in oxygenated water to cages on the Tuyamuyun Reservoir. The yield of fish seed material from larvae was 52 and 65%.

Throughout the growing season (until the end of October), the fish were raised in two cages (each with a volume of 1 m3). Next, some of the fish were transplanted into plastic tanks in closed conditions, the main part was sold as commercial fish (1.1 - 3.4 kg).

We analyzed the maturation of fish from the cultured generation. In March, in the RAS, the gonads of fish of both sexes were thin (in the form of threads), indistinguishable, and it was impossible to distinguish males from females visually. Stage 1 oocytes were visible on histological sections.

In mid-May, already at autopsy, it was possible to distinguish fish by sex; all fish had gonads at the second stage of maturity. The fish increased in size to 69 - 85 g. In microscopic sections, the most developed oocytes in females were protoplasmic growth.

At the end of July (about 6 months), in fish of both sexes (16–26 cm long, total weight 49–145 g), the gonads had already entered the third stage of maturity. In females, vacuoles appeared in the most developed oocytes

In October (at the age of more than 9 months), all opened fish (28–32 cm long, weighing 220–250 g) reached the first sexual maturity. Histological sections of female gonads showed yolk oocytes with a diameter of 0.88–0.99 mm. The females already had a rounded abdomen and a reddish genital opening. Males had a clearly visible papilla.

Discussion. It is known that the African catfish has a continuous type of oogenesis; in natural conditions there are annual cycles. But with constant warm water temperatures, females can mature throughout the year. In mature oocytes, nuclear migration is at the beginning of the stage; oocytes can be up to a year old in this phase. After gonadotropic stimulation, the nucleus and mature oocytes begin to migrate to the animal pole, and the

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eggs can be spawned. (Richter et al, 1987). This is exactly what can be used in RAS, choosing the time so that the offspring are raised to fingerlings by the beginning of the growing season.

African catfish in their natural range mature at the age of 1–2 years with a length of 20–40 cm and a weight of 150–500 g [1, 11]. Our data are in good agreement with this.

The experience shows the promise of developing technological approaches for growing African catfish in one year with a combination of winter reproduction in a recirculation system and feeding of marketable fish in open reservoirs under intensive conditions.

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