Animal Reproduction Science 159 (2015) 148–154

Contents lists available at ScienceDirect

Animal Reproduction Science

journal homepage: www.elsevier.com/locate/anireprosci

Capture, adaptation and artificial control of reproduction of *Lophiosilurus alexandri*: A carnivorous freshwater species

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ARTICLE INFO

Article history:
Received 18 March 2015
Received in revised form 8 June 2015
Accepted 9 June 2015
Available online 12 June 2015

Keywords:
Breeding
Captivity
Conservation
Parental care
Transport
Lophiosilurus alexandri

ABSTRACT

The present study describes the capture adaptation and reproduction of wild *Lophiosilurus alexandri* broodstock in laboratory conditions. There were two periods when capturing was performed in natural habitats. The animals were placed in four tanks of 5 m^3 with water temperatures at 28 °C with two tanks having sand bottoms. Thirty days after the temperature increased (during the winter) the first spawning occurred naturally, but only in tanks with sand on the bottom. During the breeding season, there were 24 spawning bouts with egg mass collections occurring as a result of the spawning bouts that occurred in the tanks. The hatching rates for eggs varied from 0% to 95%. The spawning bouts were mainly at night and on weekends. In the second reproductive period, the animals were sexed by cannulation and distributed in four tanks with all animals being maintained in tanks with sand on the bottom at 28 °C. During this phase, there were 36 spawning bouts. Findings in the present study contribute to the understanding of the reproductive biology of this endangered species during captivity.

1. Introduction

The reproduction of wild species in captivity is widely used around the world as a conservation strategy of endangered fish, and is a useful tool for the preservation or restoration of wild populations (Kelley et al., 2006; Blanchet et al., 2008; Saravanan et al., 2013). However, the task of adapting wild broodstock to laboratory conditions involves many processes, ranging from capture, transport, acclimation and maintenance of the animals in captivity (Moorhead and Zeng, 2010; Maricchiolo et al., 2014). Improper management of these actions may result in gonadal atresia and even lead to mortality of captured animals as a result of the stress response (Barton et al., 2003; Ashley, 2007; Murchie et al., 2009). Breeding in captivity also requires the study of reproductive biology of the species and the development of strategies for maintaining animals in confined conditions (Hunting Ford, 2004; Pankhurst and Fitzgibbon, 2006; Moorhead and Zeng, 2011). This is an important consideration because confined conditions can promote differences with respect to the natural behavior of the species.

The "pacamã" *Lophiosilurus alexandri* (Siluriforme: Pseudopimelodidae Steindachner, 1876) is a species that has been used for restocking the "São Francisco" River, Brazil. The reproduction of "pacamã" has been made in fish

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http://dx.doi.org/10.1016/j.anireprosci.2015.06.009
0378-4320/

stations under natural conditions, using ponds. The market value, tasty meat and resulting fishing pressure have reduced wild populations of "pacamã" which is now an endangered species (Brasil, 2014). It is an endemic fish of the "São Francisco" river (Travassos, 1960), carnivorous, benthic in habitat preference and has nocturnal behavioral patterns (Shibatta, 2003; Tenório et al., 2006). Reproduction in this species occurs between October and February (Sato et al., 2003a; Barros et al., 2007) with the males of the species caring for the egg mass (Sato et al., 2003b). The fecundity of this species is less than for many aquatic species but consistent with fecundity rates of species with the sedentary nature of this species (Santos et al., 2013). The size of vitelogenic oocytes of *L. alexandri* are large and have highly adhesive characteristics (Bazzoli and Godinho, 1997; Rizzo et al., 2002; Guimarães-Cruz et al., 2009; Santos et al., 2013). However, reproduction in controlled conditions has not been studied for this species.

The present study was conducted to assess reproductive capacity of *L. alexandri* wild broodstock after capture, transport, and adaptation in laboratory conditions.

2. Materials and methods

The present research has followed the methodology approved by the Ethics Committee on Animal Use, Protocol. 25/2010 – CEUA/UFMG.

2.1. First capture of wild animals

To capture the animals, a license of Capture and Transport was obtained by the State Institute of Forest-MG Scientific Fishing license n°105/09. The first group of animals were captured in the region of "Pontal do Abaeté" near "Três Marias-Minas Gerais", Brazil (18° 20′ 16″S, 45° 49′ 58″W). The capture period was initiated at the 1800 h between 16 and 26 September 2009. A mesh of 8–20 mm was used for the capturing and animals were collected the next morning (0600 h). Specimens captured were transported in a 190 L box boat to the "Companhia de Desenvolvimento do Vale do São Francisco" (CODEVASF) where animals were kept in concrete tanks for a week. The fish were subsequently transported to the Aquaculture Laboratory (Laqua) of the "Universidade Federal Minas Gerais, Belo Horizonte, Minas Gerais", Brazil. This transport was conducted in a 1000 L box with aeration, water temperature at 22 °C, during 4 h (380 km) of transportation. In the laboratory, the animals were submitted to acclimation. Animals were housed in a single tank of 7 m^3 covered with geomembrane liner with water conditions as follow: temperature between 25° and 27 °C and dissolved oxygen >5.5 mg L^{-1}. At this time, each animal had a microchip implanted (Microchip Parteners) in the lumbar region for identification and data collection. Once a week about 50% of the water in the tank was exchanged.

In November of 2009, the animals were transferred to a new tank with the same management specifications being imposed. At this time, two more animals were captured and submitted to the same procedures as previously described. The animals were fed daily with frozen filets of tilapia and the remains were collected after 24 h.

2.2. Second capture of wild animals

The second capture occurred in the region of "Sao José do Buriti" in the reservoir of "Três Marias in the São Francisco" River Basin (18° 42′ 33.2″S 45° 09′ 13″W) in January of 2011. For the second capture period, changes in practices occurred to improve the efficiency of the process in comparison with the first capture period.

Nets with 1500 m and mesh ranging from 7 to 15 cm among knots were used starting at the 1800 h and the animals were captured the next morning at the 0600 h. The captured animals were transported in a 190 L box with aeration. At the time of landing, the fish were weighed, subjected to prophylactic antibiotics (sulfadoxine and trimethoprim 75 mg kg^{-1}) and immediately transported to the Laqua as described for the first capture period. The transport lasted about 3 h (distance of 269 km). Upon reaching the Laqua, the animals were submitted to a 30-min acclimation and treated with potassium permanganate bath (6 mg L^{-1}) for 15 min. The animals were subsequently allocated to two tanks of 5 m^3 covered with a geomembrane liner, maintained in a static system, with additional aeration (dissolved oxygen >5.5 mg L^{-1}) and at a controlled temperature (26.0 ± 1.0 °C). The water was salinized (1 g L^{-1}) in the first 2 days. Treatment with the potassium permanganate bath was conducted again 2 days after capture.

The animals were monitored daily. Once a week, about 50% of the volume of water was exchanged in each tank. The animals were fed two to three times per week with tilapia filet and a vitamin–mineral premix (600 mg Vitamin C and 30 mg of premix). The food was offered directly to the mouth of the animals utilizing a hook.

After 15 days, the animals were weighed on a digital scale (Digital instruments FG5020). At this time, a microchip was place in each specimen as performed in the first group of captured animals.

Due to the lack of methodology for sexual differentiation, the fish of the second capture group (17 animals) and surviving animals from the first capture group (seven animals) were combined in March of 2011 and then placed in one of four 5 m^3 tanks. The following conditions and densities were imposed: Tanks 1 and 4, eight animals with an average weight of 2.304 ± 1.33 kg and 2.55 ± 1.10 kg, respectively; Tanks 2 and 3; four animals weighing 1.67 ± 0.36 kg and 1.860 ± 0.43 kg, respectively. In Tanks 2 and 4, there was approximately 5–10 cm of sand (pool filter type) added to the bottom of the tank.

Tanks of 5 m^3 were maintained with a volume of 2–2.5 m^3. The volume was reduced to avoid fish jumping out of the tank. Initially the temperature of the tank was maintained at 26.0 ± 1.0 °C with a dissolved oxygen >5.5 mg L^{-1} and a photoperiod of 10 h light. About 50% of the volume of water was exchanged weekly.

2.2.1. First breeding period

In late June of 2011 (5 months after capturing the second group of animals) the water temperature was increased to 28 °C. During the period from June 2011 to April 2012, the tanks were inspected daily in the morning and afternoon for spawning verification. When spawning bouts