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INDUCED SPAWNING OF SAHAR, *TOR PUTITORA* (HAMILTON-BUCHANAN) IN TERAI REGION OF NEPAL

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ABSTRACT

Sahar, *Tor putitora* (Hamilton-Buchanan) is a high valued indigenous riverine species of Nepal. This is declining in its natural habitat. *Tor putitora* and *Tor tor* (Hamilton-Buchanan) have been recommended as vulnerable and endangered species. Limited seed production using natural propagation has restricted its expansion in culture as well as rehabilitation in natural waters. The artificial propagation of sahar using synthetic hormone was conducted in Pokhara, AFU, Chitwan and CARP), Kathar during February to April 2017. Sixty five male (0.5-1.8 kg) and forty five female (1.1-2.1 kg) brood fish were reared in 200 m^2 earthen ponds at 1000 kg/ha. Fish were fed with 32% crude protein feed at 3% body weight per day. Maturity was observed regularly for softness of the abdomen. Female brood fish with a soft and extended abdomen were injected with synthetic hormone (Ovaprim) at 0.5 ml/kg body weight. Males were not injected hormone. The fertilized eggs were incubated in Atkin hatching trays. A total of 16 females were induced to spawn, and they produced 1630.80±184.30 (mean±SE) eggs per kg body weight. Mean hatching and larval survival rates were78.4±1.9 and 74.7±1.1%, respectively.

Key words: *Tor putitora*, spawning behavior, artificial propagation.

INTRODUCTION

Sahar, *Tor putitora* (Hamilton-Buchanan), also known as "Mahseer," is an important fish species from the glacier water of the Himalaya. It is distributed in Trans-Himalayan countries ranging from Afghanistan to Myanmar (Skene-Dhu, 1923; Mac Donald, 1948; Day, 1958; Islam, 2002). It is a well-known economically important indigenous game and food fish. Sahar is widely distributed in rivers, streams and lakes (Rai *et al.*, 1997). Local fishermen still catch sahar in lakes and rivers and commercial cultivation of this fish has still not begun in Nepal. This species is declining due to over-fishing and ecological alterations of physico-chemical and biological conditions in the natural environment (Bista *et al.*, 2007).

Sahar is known for intermittent spawning with year-round maturation. It did not spawn during January under cultured conditions. Sahar is also known to migrate a long distance from large rivers to streams for spawning during monsoon (June to August) at peak flows of rivers and streams. Insufficient availability of fish seed is a major bottleneck for its commercial production and conservation. In recent years, success in captive induced breeding in some fishery research stations and subtropical regions like in Chitwan. There is the possibility of commercial cultivation of sahar and rehabilitation in natural waters (Jha *et al.*, 2017).

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Attempts to conserve and develop culture technology of sahar had been initiated in Nepal in the past (Nepal, 1996; Acharya, 2004; Gurung *et al.*, 2002; Joshi *et al.*, 2002; Bista, 2007, 2008). Satisfactory growth in tropical and subtropical ponds had raised new hopes on the prospects of sahar aquaculture in Nepal (Shrestha *et al.*, 2005; Bista *et al.*, 2001, 2007, 2008; Rai, 2008). Omnivorous and predatory feeding habit of sahar was also proven to be a good candidate to co-culture with mixed-sex tilapia to control and better yield of tilapia (Shrestha *et al.*, 2011). The main objective was to produce seeds by induced breeding for restocking and commercial production. The specific objectives were to improve protocols for manual detection of maturity and to determine appropriate feasible methods of gonadotropic hormone injection for induce maturation and spawning of sahar.

MATERIALS AND METHODS

The experiment was conducted at the Department of Aquaculture and Fisheries, Agriculture and Forestry University (AFU), Rampur and Center for Aquaculture Research and Production (CARP), Kathar Chitwan, from September 2016 to December 2017.

Altogether 180 fish (70 female and 110 males) were reared as brood stock in a well prepared earthen pond of 200 m^2 size at Kathar and in two each of 25 m^2 in size at Rampur. Females were 3 years old and approximately 1.0 kg or more body weight and males were 1+ years. They were stocked in brood ponds at the rate of 1000 kg/ha. The male fishes were generally found ripe with milt oozing when belly pressed. Brood fishes were fed daily commercial floating pellet feed with 32% protein at 3% of total biomass.

Maturity of female fish was checked biweekly until breeding season. Male sahar can attain maturity in one year even at a body size less than 50g, but female fish first mature at the age of 3+ years. Fully mature females had a soft belly and pinkish red vent. Mature fishes were collected from ponds and held in a hammock. Readiness for spawning was examined by applying gentle pressure near the genital opening. Ripe males ooze milt and ripe females release yellow orange eggs.

Ovaprim (Salmon Gonadotropin Releasing Hormone analogue with Domperidone) was injected @ 0.5 ml/kg of female body weight (followed same dose practiced in carps in Nepal). After 24-26 hours of injection, females were ready to spawn and eggs were stripped by applying pressure on the abdomen.

The females were wrapped with a soft towel for removing water from the body before stripping to avoid water drops mixing with eggs. The clean and dried females were stripped gently to collect eggs into a clean and dried bowl. Milt from males was collected in another bowl, then mixed well with eggs for dry fertilization. In addition, 17 natural reared females were hormone injected and only 6 females found to respond. The fertilized eggs were washed several times and incubated in Atkin hatching trays by spreading one layer of eggs on a single mesh screen in the flow-through system. Water flow was maintained at 7-9 l/min. The incubation trays were covered with black plastic. The eggs were observed after 24 hours of incubation, and white eggs (unfertilized and dead) were counted and removed to protect healthy eggs from fungal infection. Hatching may require 72-96 hours depending on water temperature. The hatched larvae had large sized yolk sac and settled around stones which is already kept over the fray or corners of the incubation tray. After attaining the free-swimming stage, larvae were transferred into a happa of 3 m x 2 m x 1 m size.

RESULTS

Successful hormone-induced breeding recorded from 26 February to 4 April at water temperature between 21.4° C and 28.5°C. An average of 2331.40 ± 270.80 (mean ± SE) eggs/female and 1630.80 ± 184.30 eggs/kg body weight were obtained. There was a mean of 104.1 ± 2.5 eggs/gm egg weight. Mean fertilization rate (%), incubation period (hour), hatching an d larval survival rates were 96.8 ± 1.5, 79 - 90, 78.4 ± 1.9 and 74.7 ± 1.1%, respectively (Table 1).

Table 1. Breeding performance.

Parameter	Mean±SE
Breeding duration	2017 Feb 26-2017 April 9
Water temperature (°C)	21.4 - 28.5
Total no of female spawners	16
Mean weight of females (kg)	1.47 ± 0.09
Mean weight of males (kg)	0.76 ± 0.05
Mean total egg spawned (count)	2331.40 ± 270.80
Mean egg number per kg body weight	1630.80 ± 184.30
Mean egg number per gram egg weight	104.1 ± 2.5
Mean fertilization rate (%)	96.8 ± 1.5
Mean incubation period (hour)	79 – 90
Mean hatching rate (%)	78.4 ± 1.9
Mean hatchling survival (%)	74.7 ± 1.1

During hormone injection of naturally reared females, six females became over mature, 5 females did not respond to hormonal injection and only 35% female showed normal response. The total number of hatchlings produced was 8970; out of which 6727 fries produced with 75 % hatchling survival rate (Table 2).

Table 2. Spawning response of females.

Details	Natural
Total number of spawners (no.)	6
Over mature females (no.)	6
Not responded to hormone (no.)	5
Total eggs spawned (g)	115.0
Hatchling production (no.)	8970
Hatchling to fry survival (no.)	6727

The water temperature of brood ponds ranged from 16.2 to 31.2°C. The minimum temperature was recorded during January and maximum in July. In two breeding seasons, September to November and February to April, the water temperature was recorded ranging from 19.2 - 26.2°C and 20.4 - 29.5°C respectively (Figure 1). The first spawning occurred during a phase of rising temperature while the second spawning occurred during falling temperature.

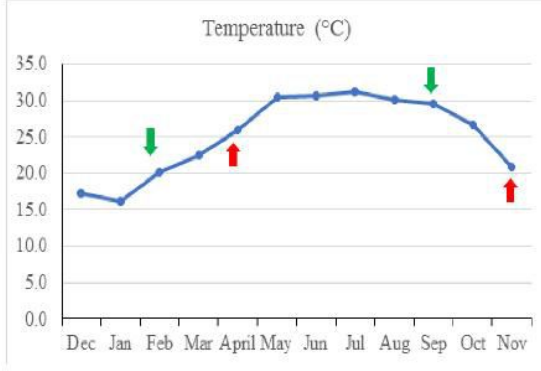

Figure 1. Water temperature of brood ponds and arrows showing spawning seasons.

DISCUSSION

Sahar has intermittent spawning behavior in nature and similar result was found in the present study. Mac Donald (1948) reported first three spawnings of sahar in a season. Pathani (1983) speculated the existence of four spawning seasons on the basis of four varied egg diameters and different developmental

stages in mature ovary of mahseer. Bista *et al.* (2010) documented natural breeding in autumn (22 - 27°C) and in spring (19 - 25°C). The first successful induced spawning occurred at water temperature 26 - 27.4°C (September-October) and better second spawning at 20 - 21°C (February-March) in Pokhara with an incubation period of 45 - 125 hours at 19 - 28°C. The shorter incubation period was found at higher water temperature (Bista *et al.*, 2010). Successful induced spawning was found at 18-24 °C pond water temperature (Pandey *et al.*, 1998).

Most findings reported sahar as a partial spawner releasing low number of eggs during a single spawning event (Shrestha *et al.*, 1990, Shrestha, 1997). Bista *et al.* (2010) also reported intermittent spawning in pond reared sahar and more than 50% spawning success at frequent brood fish inspection to determine the timing for egg stripping. The partial or intermittent spawning characteristics might be important for overall consistent reproduction in nature. Regular observation of maturity and identification of correct spawning time is critical for sahar breeding. This needs regular inspection - a time consuming work. In addition, partial spawning also limits hatchery fry production. Low fecundity of this species, compared to other cultured carps, demands more female fish for mass seed production. Recent progress on spawning in mid-hill and tropical climate and fry/fingerling production has helped to promote rehabilitation of natural stocks and aquaculture.

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