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A Study of the Breeding Efficiency of LABEO DERO in Cold Water Conditions

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I. INTRODUCTION

One of the most common food fish, Labeo dero is widely distributed throughout the foothill regions of the Himalayan ranges of India, Pakistan, Bangladesh, Nepal, Myanmar, and China (Talwar and Jhingran, 1991; Mohindra et al., 2005). It is also known as "Kalabans" in India, "Gardi," and "Kathalegi" in Nepal, and "Kursa" in Bangladesh. Usually white in color, the fish has a longer body and a comparatively tiny head. It is widespread in the Ganges and Indus river basins of India. Around 750 mm has been recorded as its greatest length. Because it is popular in the local market, it may be utilized in pond cultivation with Indian big carps. This species is considered a vulnerable fish by Mahanta et al. (1994) because to unplanned development projects of flood control and irrigation, dam building, embankments, change of river flows, and other human activities. In order to preserve this fish in its natural habitat, adequate management measures for this species should be performed. The creation of a viable technique for captive breeding is essential for both the protection of this fish's natural population and its maintenance. In captivity, both the male and the female reach gonadal maturity, but they do not naturally spawn (Pandey et al., 2014).

To encourage breeding, adult brooders are often treated with exogenous hormones such pituitary gland extracts and others (Yaron, 2009). Human Chorionic Gonadotropin, Leutinizing Hormone Releasing Hormone, and ovaprim are substitutes for pituitary extract because to the rising expense of donor pituitary and laborious procedure (Haniffa and Sridhar, 2002). Salmon gonadotropin releasing hormone analogue (sGnRH; D-Arg^{6}, Pro^{9}, Net) at a concentration of 20 μgml^{-1} and dompridone, a dopamine antagonist, at a dosage of 10 mg ml^{-1} are both ingredients in the product ovaprim (Hill et al., 2009). Dopamine antagonists are used to stop the production of dopamine, which inhibits the production of gonadotropin (Naeem and Salam, 2005). Ovaprim is mostly administered intramuscularly or intraperitoneally to fish to stimulate ovulation and spermiation (Nandeesha et al., 1990; Pandey and Singh, 1997; Raghav et al., 2012). For the cold water fish species T. khudree, T. putitora, T. tor, and hybrid mahseer, a breeding method has been devised in India (Ogale and Kulkarni, 1987; Ogale, 2002; Sangma and Basavaraja, 2010). The Kumaon area has seen attempts to produce T. putitora (Golden mahseer) (Shyam sunder et al., 1993; Ogale, 1997). Labeo dyocheilus breeding has been successfully accomplished in captivity utilizing ovaprim in cold water conditions (Pandey et al., 2011). Gogoi et al. (2016) also mention Channa aurantimaculata captive breeding in Assam. L. dero has only been the subject of one study from Nepal about semi-artificial breeding (Prasad, 2009). However, no comprehensive study on the breeding biology, breeding behavior, or induced breeding of L. dero has been done to date. As a result, the induced breeding method was used to successfully spawn fish that had been raised in captivity. The goal of the current research is to create strategies for this fish's induced breeding in captivity and in cold water.

II. Research Methodology

At the ICAR-Directorate of Coldwater Fisheries Research in Bhimtal, India, the trials were carried out. Local fisherman in Ramnagar, India's Kumaon Himalayan area, caught immature fish weighing 110–220 g in January 2011. The fish were then brought to a lab in 1000 l containers with oxygen diffusers. The young fish were raised for two years in a cemented tank with cold water (8–23.5 C) 0 and were given 3% of their body weight in traditional carp diet daily. To determine the maturity stage of the fish, the gonads from the male and female were removed and weighed separately on a single pan electronic scale. Female gonadosomatic indices were computed from April to July.

After two years, the male and female brooders reached body weights of 210–250 g and 350–470 g, respectively, and displayed complete maturity in pond environments by releasing eggs and leaking milk from the third week of July to the end of August. Mature males were identified by their light reddish vent slit and rough pectoral fins, while mature females were identified by their expanding soft belly, oval-shaped reddish vent slit, and smooth pectoral fins. The brooders were chosen and moved to FRP tanks (2.5x2.5x.75m) with a 3125 l capacity that were filled to a water level of 50 cm the day before the experiment. Each breeding pair included a female and two males. In captivity, neither sexe of this species responded to natural spawning. The chosen females were then randomly allocated to one of four treatment groups (T1, T2, T3, and T4) and given intramuscular

injections of the ovaprim hormone at doses of 0.3, 0.5, 0.7, and 0.9 ml kg^{-1} body weight, respectively. Injections of 1 ovaprim hormone at 0.2 ml per kg^{-1} of body weight were given to all men concurrently with 1 female. The hormone was given at 18:00 hours in the evening.

Fish that had been hormone-treated were placed into the FRP tanks over night and allowed to reproduce. By covering the tank with a green color net, the darkness within the tank was preserved. The quantity of eggs and the rate of fertilization were determined after spawning. Carefully fertilized eggs were moved from breeding tanks to trays with flow through systems for incubation. For each operation, the rate of fertilization, hatching, incubation time, and larval survival was noted.

To find the ideal temperature for optimal incubation, the impact of various temperatures on egg performance and survival was also studied. One hundred fertilized eggs were chosen at random for the experiment and stored in a glass jar with one liter of water. Three repetitions of each experiment were conducted with water maintained at 16, 18, 20, 22 and 24° C. The glass jar was kept in the BOD incubator to maintain temperatures of 16, 18, and 20 degrees. At the time of the experiment, the water's natural temperature was 22°C, and a thermostatically regulated electric heater kept the temperature at 24°C. Calculations were made for the fertilization and hatching rates. The physico-chemical characteristics of water were examined in accordance with APHA (2012) guidelines. The typical water temperature, pH, and dissolved oxygen levels during the experiment were 18 to 22 °C, 8.4 to 8.6, and 6.4 to 8.0 mg L^{-1}, respectively.

One-way analysis of variance (ANOVA) and Duncan's New Multiple Range Test (DNMRT) were used to statistically analyze the data in order to find differences between the means at 1% ($P<0.01$) or 5% ($P<0.05$) significant levels. The data is shown as means and standard deviation.

III. RESULT AND FINDINGS

The Gonadosomatic Index (GSI), which shows gonadal maturity in captive conditions, steadily grew in both sexes from the months of April to July and then fell in the month of August. In females raised in captivity, the GSI varied from 3.32 ± 0.143 to 14.115 ± 1.214. Similar trends in GSI were seen in L. dyocheilus and L. dero that were maintained in captivity (Singh et al., 2008; Pandey et al., 2011 and Gupta et al., 2013b). In general, adult brooders in captivity did not exhibit natural spawning, but a single intramuscular injection of the synthetic hormone ovaprim allowed L. dero to successfully reproduce without suffering post-spawning death. Significantly, T3 (ovaprim 0.7 ml kg^{-1} body weight) had a higher spawning fecundity than T2 (ovaprim 0.5 ml kg^{-1} body weight), $P<0.05$. The T3 (ovaprim 0.7ml kg body weight) group likewise had the best rate of fertilization and hatching. The hormone dosage (ovaprim) of 0.7 ml kg^{-1} body weight for females and 0.2 ml kg^{-1} body weight for males was thus determined to be the most effective for successful spawning of L. dero raised in captivity. In L. dyocheilus, induce breeding yielded results that were comparable (Sarkar et al., 2004; Pandey et al., 2011).

Fish breeding success and body weight were shown to be positively correlated. In comparison to females with smaller body weight (0.350±0.08 to 0.390±0.06 kg), those with an average body weight of 0.430±0.04 to 0.470±0.15 kg displayed bigger eggs, greater fecundity, higher fertilization rates, and better hatching rates (Table 2). L. dero had a latency period of 12–14 hours at 18±1.5º C. These findings are in line with those obtained when L. dyocheilus was treated with ovaprim (Pandey et al., 2011). In the current research, a relative fecundity of 1,47,343±110 eggs kg1 was reported. But Prasad (2009) observed that L. dero had increased relative fecundity with wild brooders. Comparable to L. dyocheilus (Sarkar et al., 2004; Singh et al., 2008 and Pandey et al., 2011) and L. bata (Hossain et al., 2007), the fertilization rate in the current research was 90±2.5%, and the hatching rate was 78±4.5%. Similar to this research, Prasad (2009) similarly noticed the fertilization and hatching rates in L. dero.

Table 3 displays the ability of L. dero to incubate eggs. It was discovered that the ideal temperature range for the egg to be incubated in coldwater settings was 18-22º C with an incubation time of 20-29 hours, which is almost identical to the L. dyocheilus egg incubation duration (18-30 hours) described by Gupta et al. (2013a). A shorter incubation time (16–18 hours) for L. dero at 24-26º C was reported by Prasad et al. (2009). According to Kikko niemi et al. (2015), lower incubation temperatures led to smaller hatchling sizes and longer hatching times.

One day hatchlings were discovered to have an average size of 3.24 ± 0.48 mm and weigh 0.005 g. At a temperature of 22 º C, yolk material was absorbed within 70-84 hours after hatching, and larvae 0 began external feeding on day 4. Compared to the survival percentage (24.1%) reported by Prasad (2009) in L. dero, the hatchling survival percentage (72%) was much greater. The findings of this study show that L. dero that has been raised in captivity may successfully reproduce when placed in water that is 18 to 22 degrees Celsius.

These discoveries will aid with L. dero seed generation, which will help with the natural stock augmentation and culture of this species. The achievement in seed production, it is argued, would be beneficial for creating L. dero as a new candidate species for the coldwater aquaculture method.

Table 1 : Breeding performance of *L. dero* in relation to body weight of females at 18±1.5 C°

Weight of female (kg)	Weight of male (kg)	Dose of Ovaprim female	Dose of Ovaprim male	Egg size (mm)	Spawning fecundity/kg body weight	Fertilization rate(%)	Incubation period	Hatching rate (%)	Remark
0.350±0.08	0.260±0.05	0.7	0.2	1.6 [b]	51,650±145[b]	69±2.5[b]	21-26[a]	55±4.0 [b]	Partial spawning
0.390±0.06	0.250±0.06	0.7	0.2	1.8 [b]	58,000±188[b]	72±2.0[b]	21-24[a]	65±4.4[b]	Partial spawning
0.430±0.04	0.250±0.05	0.7	0.2	2.8 [a]	1,34,500±210[a]	92±5.5[a]	21-26[a]	74±3.5[a]	Complete spawning
0.470±0.15	0.243±0.08	0.7	0.2	2.6 [a]	1,47,343±110[a]	90±2.5[a]	21-26[a]	78±4.5[a]	Complete spawning

Means with different superscript within the same group are significantly different (P< 0.05)

Table 2 : Egg incubation performance of *L. dero* at different temperature

Temperature (C)°	Incubation period		Hatching rate (%)	Survival rate (%)
	Hatching start(hr)	Hatching completed (hr)		
16	29	48	9±1.0[c]	4.0±0.0[c]
18	24	28	71±3.5[a]	65±2.0 [a]
20	22	29	74±4.0[a]	72±2.0 [a]
22	20	24	73±3.0[a]	70±3.0 [a]
24	16	19	66±3.0[b]	60±4.0 [b]

Means with different superscript within the same group are significantly different (P< 0.05)

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