

## Effect of photoperiod and temperature on testicular regression in *Channa punctatus*

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**Abstract:** In *Channa punctatus* testicular regression commonly observed during spawning and postspawning phases of reproductive cycle. In the present study, testicular regression was frequently noticed in fish maintained under both long photoperiod-warm temperature (LD 16 : 8-30°C) and short photoperiod-warm temperature (LD 8 : 16-30°C) regimes. Testicular regression was characterized by distortion of cellular boundary of lobules and formation of collagenous capsules containing degenerating germ cells, blood cells and colloidal mass within the lobules. The magnitude of testicular regression was more in fish exposed to short photoperiod regime (R-73.33%, SP-41.67%) than long photoperiod regime (R-50.83%, SP-19.16%) and control group (R-20.83%, SP-16.67%) in both resting (R) and spawning (SP) phases. Further, the frequency of testicular regression during resting phase was 73.33% (short photoperiod), 50.83% (long photoperiod) and 20.83% (control) whereas during spawning phase was 41.67% (short photoperiod) 19.16% (long photoperiod) and 16.67% (control). In the present study, occurrence of more testicular regression during resting phase than spawning phase may be due to change in the endogenous condition of the fish.

**Key words:** Photoperiod, Temperature, Testicular regression, *Channa punctatus*

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### Introduction

In teleosts, in spite of gametogenesis and spawning, the postspawning gonadal regression is another phase of reproductive cycle which may be synchronized by external environmental factors that trigger internal mechanisms into action. Many factors inhibit reproductive processes in teleosts resulting gonadal regression viz. endogenous rhythms, photoperiod, temperature, stress, nutrition and content of feed, water quality, pollutants, salinity, flooding and water current, weather cycles, lack of spawning substrate and disease and parasites (Rottmann *et al.*, 1991; Bromage, 1995; Pottinger, 1999; Izquierdo *et al.*, 2001; Kumar *et al.*, 2007; Srivastava *et al.*, 2008; Singh *et al.*, 2009). These factors do not function independently but are interrelated to one another (Rottmann *et al.*, 1991).

Involvement of photothermal conditions in control of reproductive processes is well recognized in several teleosts (Bromage *et al.*, 1993; Camillo *et al.*, 1993; Thomas and Arnold, 1993; Dabrowski *et al.*, 1996; Shewmon *et al.*, 2007). The low temperature (13°C) have been reported to induce gonadal regression in *Acheilognathus rhombea* (Shimizu *et al.*, 1994) Delayed photoperiod and/or temperature also induce gonadal regression in yellow perch *Perca flavescens* (Dabrowski *et al.*, 1996). Shewmon *et al.* (2007) reported 100% regressed testes in yellow perch exposed for 180 days under different conditions. Regressed testes have also been reported in *Channa punctatus* exposed to short photoperiod-warm temperature regime (Srivastava and Singh, 1987, 1992).

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The aim of the present study is to determine the effect of long photoperiod (more light less dark) and warm temperature (LD 16 : 8 at 30°C) and short photoperiod (less light more dark) and warm temperature (LD 8 : 16 at 30°C) on the testicular regression in a murrel *Channa punctatus* and also to evaluate the differential effects during resting and spawning phases of reproductive cycle.

### Materials and Methods

Specimens of adult male *Channa punctatus* were collected locally (25.5°22'N, 84°8'E) during resting (May) and spawning (August) phases of reproductive cycle. They were acclimated to laboratory conditions for 15 days under natural photoperiod and temperature. The fish were maintained in light-proof 995-l plastic tanks under the following groups (200 fish/tank) for one year with monthly sampling:

Group A : Laboratory control-natural photoperiod and temperature under laboratory conditions.

Group B : 16 hr light : 8 hr dark photoperiod at 30°C (LD 16:8-30°C).

Group C : 8 hr light : 16 hr dark photoperiod at 30°C (LD 8:16-30°C).

Illumination was provided by 40-W fluorescent tubes controlled by electric timer (AMF, Venner, Vennerette, MK 11 AT 55). Light intensity was 400 lux at the water surface. The water temperature (+2°C) was maintained by thermostatic heaters. The water in the tanks was renewed daily during the light period with fresh dechlorinated tap water. Fish were fed with dry shrimps *ad libitum*.

Monthly sampling was done in each group (10 fish/group). Their testes were taken out and fixed in the Bouin's fluid for histological studies. Sections were cut at 6  $\mu\text{m}$  and stained with hematoxylin-eosin.

### Results and Discussion

In the present study, long and short photoperiod (LD 16:8 and LD 8:16) at 30°C regimes resulted the occurrence of testicular regression. However, the magnitude of testicular regression was more in the fish exposed to short photoperiod regime (R-73.33%, SP-41.67%) than long photoperiod regime (R-50.83%, SP-19.16%) and control group (R-20.83%, SP-16.67%) in both resting (R) and spawning (SP) phases of gonadal cycle (Table 1). Further, the frequency of occurrence of testicular regression in resting phase was 73.33% (short photoperiod), 50.83% (long photoperiod) and 20.83% (control) whereas in spawning phase it was 41.67% (short photoperiod), 19.16% (long photoperiod) and 16.67% (control) (Table 1).

Testicular regression is characterized by formation of collagenous capsules containing degenerating germ cells and blood cells (Fig.1). Some of the lobules exhibited fibrosis of the lobular wall with degenerating germ cells. While other show colloidal mass (Fig. 2) and empty vacuoles in the lobules (Fig. 3).

In the present study, testicular regression were observed in fish maintained in both long and short photoperiod warm temperature regimes any time of the year, however, greater magnitude of testicular regression were observed in short photoperiod-warm temperature regime than long photoperiod-warm

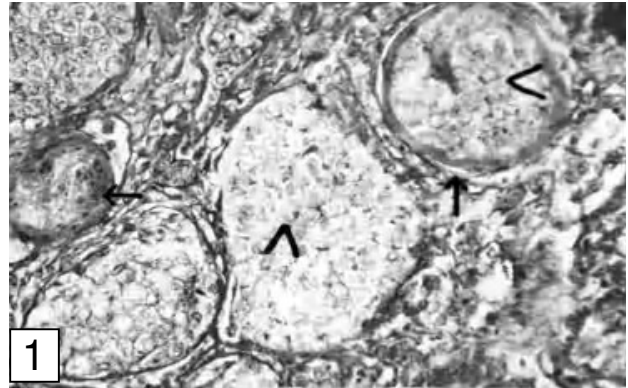


Fig. 1: Showing fibrosis of lobular membrane (arrow) and degenerating germ cells (arrow head). X 200

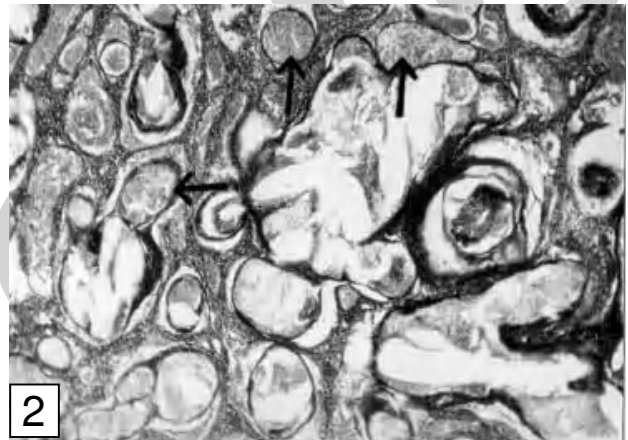
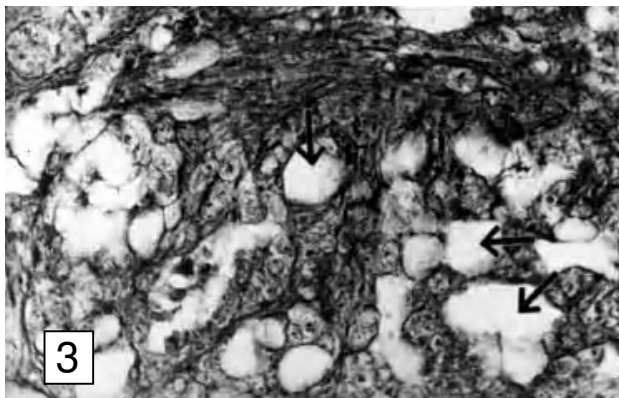


Fig. 2: Showing testicular lobule containing colloidal mass (arrows). X 125

Table - 1: Effects of constant photoperiod and temperature regimes on testicular regression during annual reproductive cycle in *C. punctatus*

Months	Percentage of testicular regression					
	Group A (Control)		Group B (LD 16:8-30°C)		Group C (LD 8 : 16-30°C)	
	E-1	E-2	E-1	E-2	E-1	E-2
May	20 (2)	x	10 (1)	x	20 (2)	x
June	0	x	20 (2)	x	30 (3)	x
July	10 (1)	x	60 (6)	x	100 (10)	x
Aug.	40 (4)	0	100 (10)	0	100 (10)	0
Sept.	100 (10)	20 (2)	100 (10)	40 (4)	30 (3)	70 (7)
Oct.	0	100 (10)	0	70 (7)	0	100 (10)
Nov.	0	0	20 (2)	0	100 (10)	90 (9)
Dec.	0	0	30 (3)	0	100 (10)	70 (7)
Jan.	0	0	70 (7)	0	100 (10)	70 (7)
Feb.	0	0	100 (10)	0	100 (10)	0
March	0	0	100 (10)	0	100 (10)	0
Apr	80 (8)	60 (6)	0	20 (2)	100 (10)	40 (4)
May	x	20 (2)	x	100 (10)	x	60 (6)
June	x	0	x	0	x	0
July	x	0	x	0	x	0
<b>Average regression (%)</b>	<b>20.83</b>	<b>16.67</b>	<b>50.83</b>	<b>19.16</b>	<b>73.33</b>	<b>41.67</b>

Values in parentheses indicate number of fish with regressed testes out of 10 fish sampled, E-1- Experiment First (May-April), E-2- Experiment Second (August-July), 0 indicates no regressed testes, x = Indicate no experiment period



**Fig. 3:** Showing vacuolisation in the testicular lobule (arrows). X500

temperature regime. Similar studies have also been made by other workers (Okuzawa *et al.*, 1989; Srivastava and Singh, 1992; Shimizu *et al.*, 1994; Dabrowski *et al.*, 1996; Koya and Kamiya, 2000; Shewmon *et al.*, 2007; Singh *et al.*, 2009).

A suppressive effect of high water temperature and long photoperiod (25 and 30°C-15 h light) on gonadal activity was demonstrated in a cyprinid fish, *Gnathopogon caeruleus* (Okuzawa *et al.*, 1989). However, low temperature (13°C) have also been shown to induce gonadal regression during early winter in *Archeilognathus rhombea* in both sexes (Shimizu *et al.*, 1994). Delayed photoperiod and/or temperature also induce gonadal regression in yellow perch *Perca flavescens* (Dabrowski *et al.*, 1996). Shewmon *et al.* (2007) reported 100% regressed testes in yellow perch exposed for 180 days under different conditions. In the present study too 100% regressed testes were encountered after prolonged exposure. Further, more testicular regression were encountered in fish exposed during resting period than spawning period. These differences may be due to changes in the endogenous conditions of the experimental fish which vary according to the phase of the annual reproductive cycle as also suggested by Okuzawa *et al.* (1989) and Shimizu *et al.* (1994).

Many factors have been suggested to be responsible for gonadal regression in fish such as environmental pollutants, endogenous rhythms, photoperiod, water temperature and stress (Shimizu *et al.*, 1994; Pankhurst and Van Der Kraak, 1997; Pottinger, 1999; Srivastava *et al.*, 2004; Shewmon *et al.*, 2007; Kumar *et al.*, 2007; Srivastava *et al.*, 2008; Singh *et al.*, 2009), nutrition and content of feed (Bromage, 1995; Izquierdo *et al.*, 2001), water levels and spawning substrate, flooding and water current, water quality, weather cycles, disease and parasites (Rottmann, *et al.*, 1991), insufficient gonadotropin hormone (Okuzawa *et al.*, 1989; Srivastava and Singh, 1993; Shimizu *et al.*, 1994; Kumari and Dutt, 1995; Dabrowski *et al.*, 1996; Zutshi, 2005) and decreased steroidogenic activity in gonads (Breton and Billard, 1984; Borg, 1994). In the present study prolonged exposure of fish to different photoperiod and high temperature seem to be responsible for testicular regression.

The photothermic manipulations may be used to maintain or delay gametogenesis in broodstock management to obtain fries whenever needed. Further, gonadal regression may be used to inhibit gametogenesis in growing fish so that somatic growth may be encouraged by conserving reproductive energy.

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