

ON AN INTERESTING CASE OF CARP SPAWNING IN THE RIVER CAUVERY AT BHAVANI DURING JUNE, 1947*

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INTRODUCTION

The fluviatile species of Indian carps generally breed during the monsoons, June to August and November to December. Hora (1945) reviewing our knowledge of the breeding conditions of Indian carps concludes that 'a heavy monsoon flood is the primary factor that influences the spawning of Indian carps and that the other topographical, chemical and physical changes in the environment of the fish are entirely dependent on it'. He further states that there is 'a consensus of opinion that the flooded condition of a river or a tank is the primary factor that is responsible for the spawning of Indian carps'. Mookerjee (1945), on the other hand, considers dissolved oxygen as a factor of primary importance in inducing spawning of fish. According to him 'practically no freshwater fish spawns without some amount of rain water mixed with the old water of the pond', and 'for major carps almost pure rain water is needed' for spawning. But in a previous contribution Ganapati and Alikunhi (1950) have endeavoured to show that spawning mainly depended on the availability of suitable shallow spawning grounds and have pointed out how Hamid Khan's observations (1947) also support the same view, although the latter arrives at a different conclusion. In the present paper a peculiar instance of carp spawning in the river Cauvery at Bhavani in South India, is described which further supports the view that while neither rain water nor turbid flood water is essential for spawning, the availability of suitable spawning grounds appears to be the deciding factor to induce spawning.

PRE-SPAWNING CONDITIONS

The south-west monsoon was practically a failure in Madras during 1947 and water level in the Stanley Reservoir, Mettur Dam, was therefore very low. There was no rain in the Mettur-Bhavani area during June. The water in the reservoir was very clear and not muddy-brown, since rains were scanty in the upper reaches also. The level of water in the reservoir was maintained at the surplus level only from the 1st to the 20th June, when the surplus channel ceased to function. The level of water in the river below the dam, consequently, was very low resulting in portions of the river-bed being exposed and dry. When the surplus channel was not functioning, limited quantities of water were

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being sent out through the sluices, for irrigation purposes and this, besides maintaining a continuous flow of water in the stretches of the river Cauvery immediately below the dam, had resulted in the re-inundation of the shallow portions of the river-bed which had previously become exposed when the surplus channel ceased to function. Owing to the failure of monsoon rains, almost summer conditions thus prevailed in the river and the water was very clear with a bluish tinge.

SPAWNING IN THE RIVER

From 23rd June 1947 onwards the River Survey Staff at Bhavani were obtaining a few eggs, almost daily, in the spawn nets fixed in the river proper, at Bhavani. The time of collection varied from 6 p.m. to 8 a.m., but the eggs were collected usually in the morning for a few hours only. These contained mostly catfish eggs; and the local staff had not made any systematic attempt to ascertain when the eggs began to appear in the nets daily and whether carp eggs were also available in the river at any other time of the day.

Detailed observations were carried out on 28th and 29th June 1947. Samples of water were collected for analysis at four-hourly intervals and by 6 p.m. spawn nets were fixed at a selected spot about a furlong below the bridge and close to Kumaramangalam on the left bank of the river near the marginal zone where the depth of water was only about 2.0 to 2.5 feet, and where there was fairly rapid flow of water from the main current. The nets were examined at hourly intervals but till 11 p.m. no spawn was collected in them. From 12 p.m. (mid-night) onwards carp eggs began to be caught in the nets in large numbers. The physico-chemical conditions of water prior to and during collection of spawn were as shown on page 142.

The water was flowing at a velocity of about 5 miles per hour. Phytoplankton was fairly rich and representative, and consisted of Myxophyceae (*Merismopedium*, *Microcystis*, *Oscillatoria*, *Anabaena* and *Anabaenopsis*), Chlorophyceae (*Scenedesumus* and *Mougeotia*), Bacillariae (*Synedra* and *Navicula*), Dinophyceae (*Peridinium* and *Glenodinium*), and Euglenophyceae (*Euglena*). Zooplankton was poor and consisted of stray specimens of copepods (*Cyclops* and *Diaptomus*) only.

During the period of about 22 hours there had been no appreciable change in the physico-chemical variables of the river water. While neither the actual spawning ground nor the process of spawning was observed, the fact that there was no appreciable change in the physico-chemical conditions immediately prior to and immediately after spawning probably shows, that the spawning conditions were not widely different.

NATURE OF THE SPAWN COLLECTED

The mid-night collection contained fertilized, developing eggs, in advanced stages of segmentation. All the eggs were more or less in the same stage of development—the blastoderm cells about to commence invasion of the yolk. The eggs were almost transparent, with spacious perivitelline area. The diameter ranged from 2.8 mm. to 4.0 mm. There were no catfish eggs. Three distinct sizes could be distinguished in this collection of eggs. These were isolated and kept for rearing

TABLE I

Physico-chemical conditions of water in the River Cauvery, at Bhavani on 28th and 29th June 1947, when carp spawn was collected.

Date	Pre-spawning 28-6-'47				During (?) and immediately after spawning 29-6-'47								Remarks
	6 p.m.		10 p.m.		12 Midnight		4 a.m.		6 a.m.		10 a.m.		
	Sur.	Bot.	Sur.	Bot.	Sur.	Bot.	Sur.	Bot.	Sur.	Bot.	Sur.	Bot.	
Meteorology	No moonlight—No rains												
Colour	Bluish-green												
Turbidity	>30 cms.												
Depth at collection spot.	2.0—2.5 ft.												
Temp. (°C)	29.4	29.3	29.3	29.3	28.8	28.8	28.3	28.3	28.2	28.2	28.8	28.7	
Free CO ₂	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	
CO ₃ *	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
HCO ₃ *	18.147	18.300	17.995	17.995	17.995	17.690	17.995	17.690	18.300	18.300	17.690	17.690	
pH.	8.7	8.6	8.6	8.6	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	
D.O. (cc./L.)	5.165	5.305	4.886	4.886	4.746	4.746	4.746	4.746	4.886	4.886	5.016	4.956	
% Sat.	92.9	94.2	86.7	86.7	83.6	83.6	82.9	82.9	85.2	85.2	88.3	88.3	
Chlorides*	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	
P ₂ O ₅	+	+	+	+	+	+	+	+	+	+	+	+	
NO ₃ N	+	+	+	+	+	+	+	+	+	+	+	+	

*Results expressed in parts per 100,000.

for purposes of identification. The nets were thereafter cleared at hourly intervals. Collections continued to be heavy, but eggs in advanced stages of cleavage were not available. Embryonic development had progressed in the meantime and as the day advanced only eggs with well differentiated embryos, executing movement inside, could be procured. These later collections contained about 10% of catfish eggs which were easily distinguished by their greater opacity and the conspicuous zona radiata forming a thick membrane outside the vitelline membrane. By about 8 a.m. carp eggs were not available in the river and the net collections contained only few catfish eggs with fairly advanced embryos.

The collections were repeated on 30-6-47 (night) also, but were not as heavy as on the previous night.

The different types of eggs were carefully described and reared in the laboratory. Samples were transported to Madras and after successful rearing for about three weeks, were identified. The largest eggs, about 4.0 mm. in diameter, were those of *Labeo fimbriatus* (15%), the medium sized eggs (about 3.4 mm. in diameter) were those of *Cirrhina reba* (60%) and the third type, the smallest (diameter, 2.8 mm. to 3.0 mm.) were those of *Garra mullya* (25%). Details of the embryonic and larval development of these species are described by Alikunhi and Rao (1951). The catfish eggs could not be reared to the stage at which they could be identified for species.

DISCUSSION

Upto 3-6-1947 carps had been spawning in the Cauvery, every day, continuously for over a week. On 29-6-'47 when a thorough study was made and collections were taken during the night, large number of eggs could be obtained. Spawning on the 30th also was fairly heavy. While, on the previous days, no attempt was made to collect spawn either during the night or in the early morning hours, the collection of only limited number of catfish eggs after 6 a.m. does not preclude the possibility that spawning might have been more or less heavy during these days also. In all probability spawning was perhaps continuing after the 30th June also. Extended spawning has thus been taking place in the river and all these days almost summer conditions were prevailing in the locality and all along the river. No sudden fluctuations in the physico-chemical conditions of water were recorded during this period. Monsoon floods and turbid flood water that are generally associated with carp spawning were *absent* in the present instance where the river water was perfectly clear and had a bluish-green colour. As there were no rains during this period and as only stored and settled water was being discharged from the Stanley Reservoir, at Mettur Dam the river water had no admixture of fresh rain water either. In spite of these, the conditions were congenial for *L. fimbriatus*, *C. reba* and *G. mullya* for continued spawning. It is thus an instance which seeks exception to the statements that a heavy monsoon flood is the primary factor that influences spawning of Indian carps (Hora, loc. cit.) and that practically no freshwater fish spawns without the influence of some amount of rain water (Mookerjee, loc. cit.). The observations of Hamid Khan (loc. cit.) also support the above conclusion, although his own inference is that sexual play of the breeders induces spawning.

In the Batala fish farm in the Punjab he found that so long as the breeders remained confined in the tank, they did not spawn even when flood water entered the tank, but when they were given access to inundated fields they spawned. It is therefore obvious that availability of and access to shallow spawning grounds was the deciding factor that induced the fish to spawn. While the instance of spawning recorded in the present paper took place under extraordinary circumstances, it clearly shows that even when the monsoon fails, if spawning grounds are available the fish readily spawns.

While large numbers of eggs were collected, the actual spawning grounds could not be located and the process of spawning was not observed. The exact conditions of the water at the spawning ground at the time of spawning are therefore not known. However, as already indicated, the facts that the physico-chemical conditions of water in the river for over a week were more or less uniform and that the pre- and post-spawning conditions do not show any significant difference probably justify the assumption that the spawning conditions were perhaps the same as those soon after spawning, when the first collection of eggs was detected in the nets. A critical study of the physico-chemical conditions attending spawning (vide Table I) shows that factors like turbidity, flow of water, pH., dissolved oxygen, percentage of saturation of dissolved oxygen, free carbon-dioxide, etc. had not appreciably changed at the time of spawning. The dissolved oxygen and percentage of saturation during day time (10 a.m.) as also in the evening (6 p.m.) when no eggs were available, were higher than the same at 10 p.m. to 12 midnight when eggs began to appear in the nets. The view that high dissolved oxygen content which is associated with rain water is the deciding factor for inducing spawning cannot, therefore, be supported from the present observations. While the temperature of water during the day did not show any marked fluctuations, it was found that during the time of spawning (when the first lot of eggs were collected) there was a slight reduction in temperature, accompanied by homothermal conditions from top to bottom. The eggs collected at 12 midnight being 3 to 4 hours old after fertilization, the spawning time is indicated as 8 to 9 p.m. The temperature of water in the river at that time was about 0.5°C higher than that at 12 midnight. Homothermal conditions probably prevailed from 9 p.m. onwards. Other than this factor there is nothing to explain why the fish were spawning only in the night.¹ The almost routine manner in which spawning had been taking place in the river for over a week also probably indicates that no particular factor other than the diurnal fluctuations in temperature was immediately responsible for inducing them to spawn during the night. These fluctuations are, however, very slight and since major carps are known to spawn at all times of the day, some other explanation has to be sought for this continued spawning during nights only. Of course, the re-inundation of shallow portions of the river-bed by water discharged from the sluices in the Mettur Dam had provided ample suitable spawning grounds in the river itself. When the surplus channel of the dam is functioning, the water level in the river will be high and naturally there will be considerable depth of water over the

¹ Can perhaps light intensity have any effect on actual spawning?—EDS.

above mentioned shallow portions of the river bed. But as already explained, when the surplus ceased to function there was a sudden lowering of the level which exposed the shallow portions. The discharge of water from the sluices started on the 21st June and the collection of eggs from the 23rd June onwards indicates that the fish had responded quickly to the re-inundation of the shallow spawning grounds. It would thus be apparent that the availability of and access to suitable spawning grounds with shallow depth of water at the right time of maturity of the fish is the most important single factor that induces spawning of carps.

The eggs that were first caught in the nets at midnight on 28-6-'47 were only about 3 to 4 hours old after fertilisation. Assuming that as soon as laid these eggs were drifting with the current which was flowing at the rate of about 5 miles per hour, the spawning would have occurred in the river about 15 to 20 miles above the collection spot. Later collections procured only eggs in advanced stages of differentiation and according to the above assumption the eggs collected at 6 a.m. at Bhavani, being about 9 to 10 hours old after fertilization, should have been liberated at about 45 to 50 miles above the collection spot. This however, appears to be highly improbable since spawning in all probability had taken place at one or more points below the Mettur Dam only, which is about 27 miles above Bhavani.

It is therefore possible that fish began to spawn, more or less at the same time, in scattered spawning grounds within the 27 miles stretch of the river between Mettur Dam and Bhavani. Spawning might have taken place in relatively sheltered places where the current was not fast. The eggs would take a longer time to drift into the main current from such places than when they are laid in the main current itself; and hence the nearest spawning ground from the collection spot might well have been within a couple of miles distance. The eggs from the nearest spawning grounds to the collection spot got drifted and were caught first, while those from farther grounds took a longer time to be drifted into the nets and were thus in advanced stages of differentiation.

SUMMARY

1. A peculiar instance of carp spawning in the river Cauvery, within the Mettur-Bhavani stretch under almost summer conditions, is described.

2. Monsoon floods and turbid flood water generally associated with carp spawning were absent and the water was clear and bluish-green in colour.

3. The dissolved oxygen content and the percentage of saturation of dissolved oxygen in water were not higher at the time of spawning than at other times of the day.

4. Other physico-chemical factors like flow of water, pH, free carbon dioxide, carbonates, bicarbonates, etc., did not show any significant variation during pre-spawning, spawning and post-spawning periods.

5. Availability of and access to suitable shallow spawning grounds with shallow depth of water, even in the river bed itself, at the right stage of ripeness of gonads appear to be the most important factors inducing spawning.

6. Fish appear to spawn more or less at the same time, in a fairly long stretch of the river, in areas where the current is slow and from where the eggs slowly get drifted into the main current.

7. The spawn collected was reared in the laboratory and was identified as that of *Labeo fimbriatus*, a major carp of the Cauvery, *Cirrhina reba*, a minor carp extensively used for stocking purposes and *Garra mullya*. Catfish eggs collected could not be reared.

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