A PRELIMINARY REPORT ON THE INDUCED BREEDING OF THE COMMON CARP

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Interest in artificial spawning grew during the last decade. Successful spawning, all of the culture of a marine teleost such as the grey mullet, **Mugil cephalus,** Linnaeous, was reported in Taiwan (Liao, 1969; Tang, 1964) and Hawaii (Shehadeh and Ellis, 1972). Information on the induced breeding of freshwater species is scant, although various carp species are bred in this manner in Taiwan (Tang, 1960; Liu, 1964; Lin, 1965), Africa, China and India (See: Laconilao, 1973). In the Philippines, lack of trained fish endocrinologist is primarily why artificial breeding of fish is not widely done (Laconilao, 1973). Successful production of catfish fry by hormones injection was done at the University of the Philippines College of Fisheries but published materials on it are not available.

The Philippines have for artificial breeding at least four fishes – the freshwater catfish, the common carp, mullet and milkfish. Catfish and carp are excellent experimental and culture fishes because spawners are not difficult to obtain and are easy to handle.

Carp is abundant in Lake Lanao. The common carp, **Cyprinus carpio,** Linn., was planted by Alvin Seale of the Bureau of Science in Lake Lanao in 1915 and in 1916. From then on, it thrived abundantly, becoming a major source of the fishing industry. Villaluz (1966) reported that carps composed more than 11.94 per cent of the fish landed in 1963-64. But in our present observation, Lake Lanao seems fast depleted of carps due to overfishing and mismanagement. Many carps landed at the Marawi City market were breeders, mostly ripe females because, according to fishermen, the gravid females command higher

prices than the non-gravid or male. As a result, only 25-40 kilograms of carps are landed daily in the city market in 1973, compared to 300-1,000 kilograms landed daily in 1963-64.

Carp fish farming has not been developed in Lake Lanao or any other area in Mindanao, primarily because of the difficulty of obtaining fingerlings for stocking.

This study on induced breeding of common carp aims at finding a method of producing sufficient carp fingerlings to supply the fish farmers in Lake Lanao and other parts of Mindanao, and to help develop carp farming – thus increase the people's income in these areas.

This is a preliminary report of nine experiments conducted at the MSU College of Fisheries Hatchery Laboratory in December, 1973 to May 3, 1974.

MATERIALS AND METHODS

Spawners. Eleven carp spawners used in the experiment were collected from different sources. Some came from the MSU College of Fisheries fishpond; others were either purchased or borrowed from local fishponds. They were taken to the College of Fisheries Hatchery Laboratory, where the stock tanks were located. They weighed 300-1,500 grams and measured 23-30 cm.

Stock tanks. A rectangular outdoor tank (3 m x 8 m x 1 m) was used to acclimatized the spawners. It has a fresh water riffle system for aeration and water freshening.

Glass and wood aquaria. Four glass aquaria (each measuring 50 cm x 93 cm x 76 cm) and a wood aquarium (1 m x 7 m x 1.5 m), were utilized to hold the spawners after injection. The water level of these aquaria was maintained at 40 cm by an exit tube mounted vertically from its base.

Selection of spawners. The criteria for selecting female spawners are based on the works of Lin (1965), Clemens (1968) and Chaudhuri (1968). They include: (a) the destention of the belly due to ovarian enlargement; (b) swelling of the cloacal region; and (c) flabbiness of the abdomen. The mature males used in the experiments were easy to identify: the abdomen of male carps were pressed gently and if milt oozed out, then the carp was sexually mature.

Dissection and removal of gland. The glands were collected from newly-killed fresh mature carps. These carps were purchased from the Marawi City market; others were donated by local fishpond owners and five were collected from the experimental fishponds of the MSU College of Fisheries. Their skulls were cut longitudinally with a kitchen knife, the dorsal portion removed, exposing the brain. The entire brain was lifted by detaching the olfactory gland-optic nerves. The pituitary gland, which is located ventrally, just posterior to the optic nerve crossing or optic chiasma, was then removed with forceps and immediately soaked in acetone solution and stored in a refrigerator. In some experiments, fresh glands collected were immediately injected to the carp spawners.

Preparation of gland suspension for injection. The preserved glands were placed to dry on a piece of filter paper. The required quantity of glands were ground in a watch glass with about 3 cc of penicillin solution (10,000 units).

Hormones treatment. The hypophysation technique used in the experiment were those of Lin (1965) and Clemens and Sneed (1962). The first injection was given intramuscularly to the spawners five minutes after the preparation of the suspension, and 30 minutes after transferring them to the glass aquaria from the stock tank. The second injection was given six hours after the first injection. The treatment for each fish was two to five carp pituitary glands mixed with 3 cc penicillin solution per injection.

Egg collection and fertilization. The spawners were observed every hour to determine closely their ovulation time. Twenty to thirty minutes after each injection, the carps' body color changed and their belly became soft. Four spawners were allowed to ovulate in the aquaria and the male fertilized the eggs in the natural way. The fertilized eggs were collected and transferred to the hatching tank.

Artificial fertilization (dry method) was used in all other spawners. This was done by stripping–squeezing the eggs and sperms out – both the female and male. In stripping, a person, holding the fish obliquely with its abdomen downward, lightly squeezes the fish abdomen – from the pelvic fin to the anus. If the fish were ready, eggs or sperms would flow out. The eggs and sperms were collected on the plastic pan.

They were carefully stirred together with a goose feather to complete the fertilization.

An experiment using three spawners was made to study the effect of light on them. After injection, one spawner was lighted with a 165-watt mercury lamp, the other a 100-watt bulb, while the third one was not lighted at all.

Incubation technique. Hatching was done in a circular tank (area: 24.6 sq. m.), whose water level was maintained at 65 cm. Because there was no aerator, a water riffle system was utilized. The hatching trays, each made of fine nylon netting and each measuring 20 cm x 60 cm, were suspended in the tank. Their mesh of about 1.3 mm is small enough to retain the eggs, but big enough for the larvae to pass through.

The experimental fishpond (15 m x 15 m) prior to the experiment was fertilized with chicken dung and chemical fertilizer. A week later, four hatching nets, called **karpaban**, each measuring 5 m x 3 m x 0.40 m, were placed in the fishpond. They were suspended on bamboo poles (Fig. 1 and 2). The mesh of the hatching net **(karpaban)** were too small for the eggs and the larvae to pass through.

Fishpond plankton sampling. Plankton samples were collected from the experimental fishpond 10 days after the application of fertilizers. These were gathered at different times of the day (7:00 a.m., 12:00 noon and 7:00 p.m.). These were preserved in a formalin solution (4 per cent) and later examined at the Department of Biology laboratory.

Rearing of larvae. The larvae were reared both in the circular tank and experimental fishpond (inside the net). The water in the circular tank was refreshened by the water riffle system.

RESULTS

Nine (81.9 per cent) of the 11 spawners, ovulated and two (19 per cent) failed to ovulate. The spawners that were lighted had shorter ovulation time – 3 to 4 hours.

Table I shows the different responses of the spawners.

Egg collection and fertilization. As shown in Table I, it took

spawners 1, 4, 5, 6, 8, 9, and 10 ten to fifteen hours to release the eggs. Spawners 2 and 3 ovulated in the glass aquaria 3 to 4 hours after the first injection.

Fertilization rates varied from 13 per cent to 27 per cent (in the case of natural fertilization) and 34 per cent to 65 per cent (in the case of artificial fertilization).

Hatching. The hatching rate of eggs incubated in the circular tank was low (12-15 per cent) because they were attacked by the fungus, **Saprolegnia** that attached itself to the fertilized eggs. We suspected that the fungus was carried by the water that flowed in during the experiment. The hatching rate of eggs incubated in the experimental fishpond **(karpaban)** was higher (27-34 per cent). The water temperature of the circular rank and the experimental fishpond varied from 22-24 degrees centigrade. Eggs of seven spawners hatched between 53-55 hours, and eggs of the other two spawners hatched between 41-48 hours.

Larvae and rearing of larvae. The newly-hatched larvae measured 4.4 to 4.6 mm and moved like wrigglers. Many of these larvae aligned themselves at the sides of the hatching tray and net.

The yolk sacs appeared to be oblong masses, 3.2-3.5 mm long. They disappeared 3.5 days after hatching. The larvae started feeding on the fourth day. On examination, the digestive tract of the larvae showed that phytoplanktons **(Chlorella** and **Oscillatoria)** were their initial food items.

The plankton sampling in the fishpond and the hatching net **(karpaban)** showed the presence of phytoplanktons and zooplanktons. These include the Genera: **Gleocopsa, Anabaena, Daphnia, Cyclops, Scenedesmus, Chlorella** and **Oscillatoria.** Since some of these planktons were found inside the hatching net **(karpaban)** we assumed that the mesh of the net allowed their free movement from the outside to the inside and vice versa. The planktons thus became the food for the larvae, although these were supplemented with hard-boiled egg yolk (one egg yolk per day) from the fourth day to the fifteenth day after hatching.

The 4th-15th day after hatching were considered "critical" days of the larvae. During this period, the mortality rate of the larvae in the circular tank was 34 per cent. However, of the larvae reared in the fishpond, only 10 larvae died (0.034 per cent) in this period.

Discussion

The data show that of the spawners injected with hormones, 81.8 per cent appeared to be their ovulating rate. The fertilization rate of artificially fertilized eggs is relatively high. Whether this method is best for fish farmers cannot be ascertained yet.

The pituitary treatment given the spawners seems in general to be a good dosage. But it cannot be ascertained yet whether a higher dosage would give better results. Studies on hormone dosage as well as on intervals between injections are in progress.

The differences in ovulating time may be attributed to the degree of spawners maturity or to the degree of its ovarian development. This is in agreement with Shehadeh and Ellis (1970). Further studies on ovarian and sperm development are now in progress.

The rearing of the larvae, appears to be a crucial stage, because the mortality rate of the larvae tended to go up if no proper care is given the larvae.

Our preliminary study indicates that the carp larvae initially feed on phytoplanktons. This however needs to be checked in succeeding experiments.

The method of enclosing the larvae with the net seems successful in preventing predators and in preventing other animals from competing with them on food items.

The success of this preliminary study demonstrates the feasibility of inducing carp ovulation under laboratory condition. The fertility of the eggs, however, remains doubtful.

The relationship of larval growth to yolk sac depletion and larval survival to temperature are still being studied. The studies on the growth rate of the fish, and the effects of the pituitary hormones on ovulation and spermiation, are also in progress.

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Table I. **RESULTS OF EXPERIMENTS ON INDUCED BREEDING OF COMMON CARP**

Spawners No.	INJECTION First Date/ Time	First Dosage	Second Date/ Time	Second Dosage	Date of Ovulation & Time	Ovulation time after first injection	Rate of fertilization (Approx.)	Date of hatching & Time	Hatching after fertilization	Weight (gms.)	Length (cm.)	REMARKS
1	12/16/73 1600 Hrs.	3 mg. per kg. body weight	12/16/73 2200 Hrs.	3 mg per kg. body weight	12/17/73 0400 Hrs.	12 Hrs.	27%	12/19/73 0900 Hrs.	53 Hrs.	300	23	Change to yellowish coloration* observed after each injection, enlargement of the belly and swelling of the cloaca after the first injection. The belly more enlarge after the second injection. The spawning is natural.
2	1/4/74 0900 Hrs.	50% of equal body weight	1/4/74 1300 Hrs.	50% of equal body weight	1/4/74 1300 Hrs.	4 Hrs.	20%	1/7/74 0700 Hrs.	54 Hrs.	500	24.5	Body coloration changes to yellowish*, belly greatly enlarged after first injection. Ovulation occurs few minutes after second injection. Spawning natural. Lighted overhead with 100-watt bulb.
3	1/4/74 1000 Hrs.	50% of equal body weight			1/4/74 1300 Hrs.	3 Hrs.	23%	1/7/74 0700 Hrs.	54 Hrs.	750	25	Body coloration changes to yellowish, belly enlarged after first injection, ovulation occurs few minutes after first injection. Spawning was natural. Lighted with 165-watt Mercury bulb.
4	1/4/74 2100 Hrs.	50% of equal body weight	1/5/74 0300 Hrs.	50% of equal body weight	1/5/74 0900 Hrs.	12 Hrs.	13%	1/7/74 1400 Hrs.	54 Hrs.	500	24	Body coloration changes to yellowish, enlargement of the belly and swelling of the cloaca observed after first injection. After the second injection, the belly was greatly enlarged. Spawning was natural.
5	1/2/74 2110 Hrs.	50% of equal body weight	1/26/74 0300 Hrs.	50% of equal body weight	1/26/74 1250 Hrs.	15 Hrs.	34%	1/28/74 1935 Hrs.	54 Hrs. and 35 mins.	350	24.5	Body coloration to yellowish, no significant enlargement of the belly observed after the first injection. The belly enlarged 3 hours after the second injection. Artificial fertilization performed 20 minutes after the extrusion of some eggs.
6	4/1/74 1900 Hrs.	3 mg.	4/2/74 0100 Hrs.	3 mg.	4/2/74 1105 Hrs.	15 Hrs. and 55 mins.	65%	4/4/74 0500 Hrs.	41 Hrs.	1000	–	Change of body coloration occured one hour after the first injection; 10 minutes after the second injection; rapid movements of the female and pairing observed 11 hours after the first injection; swelling of the cloaca and enlargement of the belly observed 6–7 hours before ovulation.
7	4/1/74 2000 Hrs.	3 mg.	4/2/74 0205 Hrs.	3 mg.	–	–	–	–	–	1000	–	Fresh gland was used, change of body coloration observed 20 minutes after the first injection, 6 hours after the first injection, the second dose was given. No sign of spawning behavior. Some eggs were extruded out but no ovulation occured. Third and fourth injection given.

Table I. **RESULTS OF EXPERIMENTS ON INDUCED BREEDING OF COMMON CARP**

Spawners No.	INJECTION First Date/ Time	First Dosage	Second Date/ Time	Second Dosage	Date of Ovulation & Time	Ovulation time after first injection	Rate of fertilization (Approx.)	Date of hatching & Time	Hatching after fertilization	Weight (gms.)	Length (cm.)	REMARKS
8	4/2/74 1510 Hrs.	1.5 mg.	–	–	4/3/74 0400 Hrs.	12 Hrs. and 50 min.	52%	4/5/74 1645 Hrs.	48 Hrs and 45 min.	750	–	Change of body coloration observed 10 minutes after the first injection. Swelling of the cloaca and enlargement of the belly were observed 6 to 7 hours before ovulation. No second injection was given.
9	4/12/74 1445 Hrs.	1.5 mg.	4/12/74 2015 Hrs.	1.5 mg.	4/13/74 0100 Hrs.	10 Hrs. and 15 mins.	60%	4/15/74 0845 Hrs.	55 Hrs. and 45 mins.	863	–	Two injections were given at intervals of five hours and 30 minutes. Change of body coloration observed.
10	4/12/74	1.5 mg.	none	none	4/13/74 0230 Hrs.	11 Hrs. and 30 Mins.	57%	0845 Hrs.	54 Hrs. and 15 Mins.	700	–	Only one injection was given, change of body coloration occured 10 minutes after injection, swelling of the cloaca and enlargement of the belly observed after 6 hours.
11	4/12/74 1600 Hrs.	1.5 mg.	4/12/74 2215 Hrs.	1.5 mg.						700	–	Change of body coloration observed after the first injection. No ovulation observed.

**Observed 20 minutes after each injection*

Fig. 1. The second net (**karpaban**) is being installed by research assistants Blas Tabaranza, Jr. and Daniel Tobias, Jr.

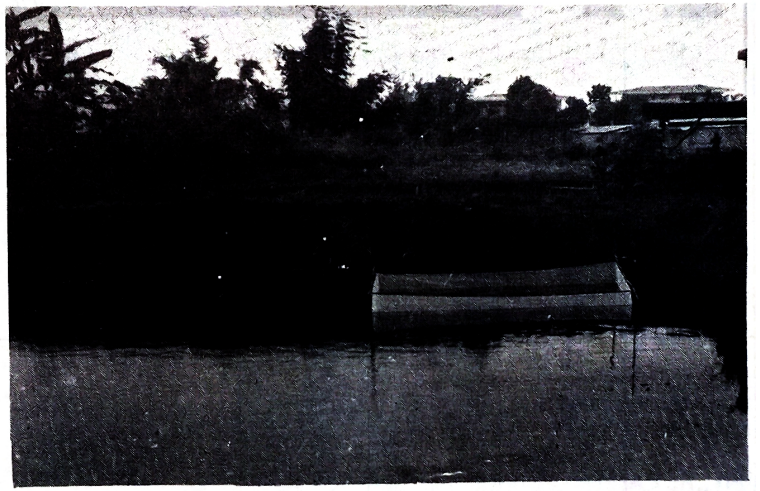

Fig. 2. The net (**karpaban**) suspended in the experimental fishpond, a week after application of chicken dung.

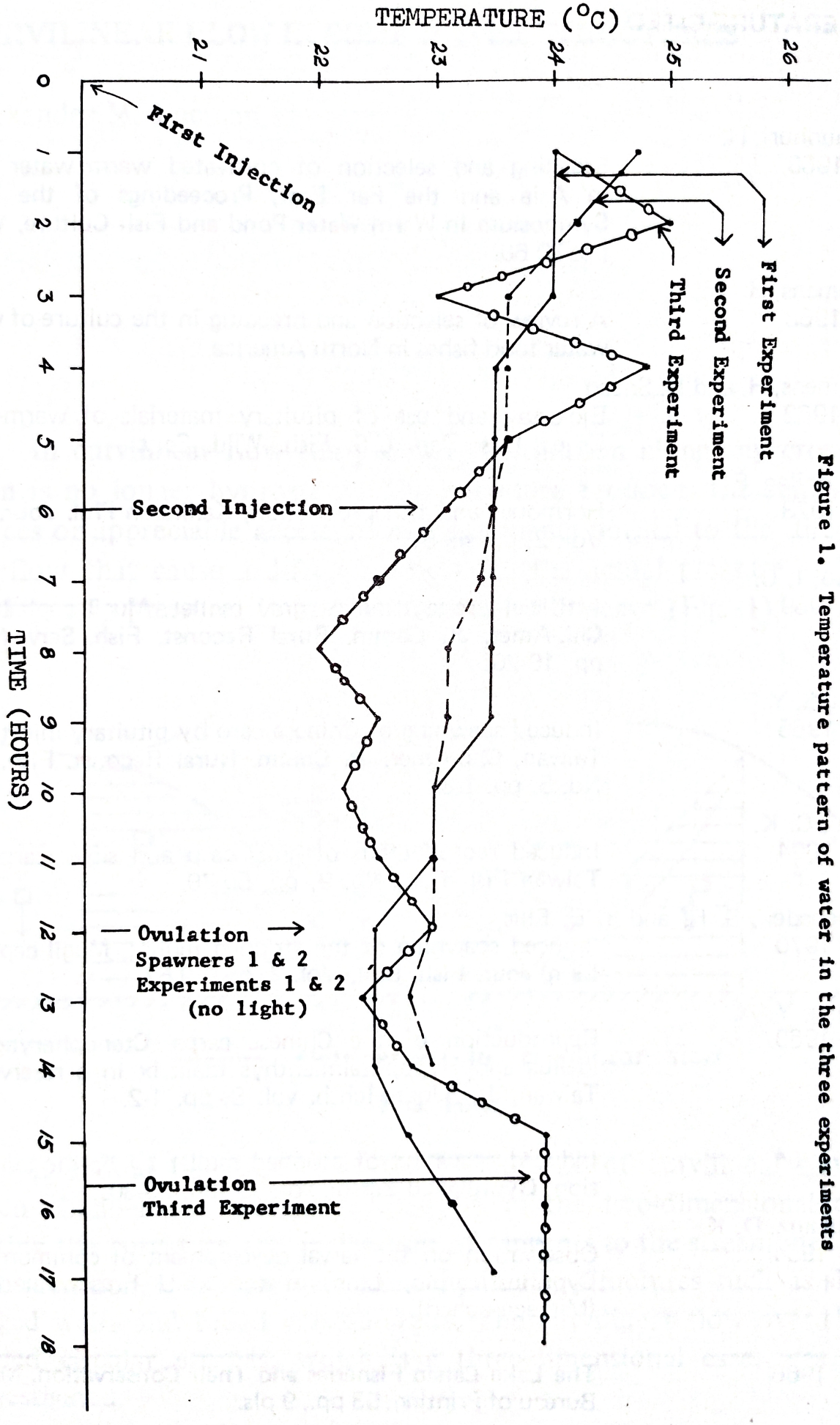

Figure 1. Temperature pattern of water in the three experiments

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