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BIOLOGY OF ANGELFISH

BREEDING BIOLOGY AND LARVAL DEVELOPMENT WITH A NOTE ON ITS MANAGEMENT — PART I

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RINGKASAN

Pembiakan dan pembesaran larva ikan Angel telah diterangkan. Kita menhadapi masalah untuk menentukan jentinanya di peringkat awal. Di peringkat dewasa bagi jenis jantan, kepalanya lebih berbentuk cembung daripada jenis betina dan juga bahagian perut jenis betina lebih mengembang. Jika dilihat daripada bahagian perut dari hadapan didapati ia berbentuk cekong bagi ikan jantan dan cembung bagi ikan betina. Taraf taxonomi bagi genus ini telah dibincangkan. Cara-cara bertelur bagi species ini adalah agak rumit sedikit. Kira-kira 350-1300 telur dikeluarkan pada tiap-tiap kali ia bertelur. Telur-telur itu mengambil masa lebih kurang dua tiga hari untuk menetas dan larva-larva boleh berenang bersendirian dalam masa kira-kira empat hari. Larva-larva ini akan menyerupai ikan dewasa (jenis ini juga) dalam masa sebulan. Satu keterengan ringkas berkenaan dengan teknik pembiakan dan cara menjaga ikan jenis Angel telah diberi.

INTRODUCTION

This paper deals with the breeding biology and larval development of Angelfish(*Pterophyllum eimekei/scalare*). It forms the first part of a comprehensive study on the biology of this species.

Of the 20,000 species of fishes known, only the breeding habits of about 400 have been described (BREDER AND ROSEN, 1966). Though the breeding habits of Angelfish are well-known to aquarists for a long time, there has been no comprehensive study on their breeding biology. In its native habitat in South America, this species is said to spawn during rainy seasons (LOWE MCCONNEL, 1969). With a few exception, the vast volume of popular aquarium publications which are often unreliable, are generally ignored in this study.

The reproductive behaviour of Angelfish and other Cichlid fishes has been reviewed by BREDER and ROSEN (1966). The ecology and taxonomy of this and other South American Cichlids have been described by LOWE MCCONNEL (1964 and 1969).

MATERIALS AND METHODS

Adult Angelfish were purchased from local aquarium shops in April 1972. They were placed in community breeding tanks of 200 litres capacity and individual breeding tanks of about 45 litres capacity. Latex cup/mango leaf/saucer were placed in the tanks to serve as substrata for egg deposition.

The fish were fed twice daily with tubifex worms and occasionally with mosquito larvae, waterfleas and young *Macrobrachium lanchesteri* de Man. Observations on the breeding behaviour, number of eggs laid, duration of embryonal development, percentage of hatch-

ing and spawning frequency were noted. When the pair finished spawning, the eggs were removed and transferred into an aerated 18-litre basin for hatching. The fish larvae were fed with egg yolk or artemia larvae twice daily. About 10 larvae were taken daily for a month for the study of their development. The larvae were examined alive under a microscope using low power magnification. Camera lucida drawings of the larvae were made to show their morphological characteristics. The larvae were subsequently preserved in 10% formalin for future reference.

Diurnal variations in temperature of the larval tanks kept in the aquarium shed and the lecture room were recorded with a minimum-maximum thermometer (*Table 1*). Some physico-chemical properties of the tap and rain water stored in the underground tank were also analyzed (*Table 2*). Excess food and decayed organic matter in the tanks were siphoned out whenever necessary.

30 matured female fish were killed and their ovaries were dissected out. The ovaries were fixed in Gilson's Fluid and later counted for the number of eggs in each fish (*Table 3*).

TABLE 1. THE MINIMUM AND MAXIMUM TEMPERATURE IN THE HATCHING AND LARVAL TANKS IN THE AQUARIUM SHED AND LECTURE ROOM TAKEN DURING 31ST MARCH, 1973 TO 7TH APRIL, 1973

Aquarium Shed (°C)		Lecture Room (°C)	
Minimum	Maximum	Minimum	Maximum
24.8 ± 0.4	30.4 ± 1.7	26.5 ± 0.5	29.4 ± 0.9

TABLE 2. CHEMICAL ANALYSIS OF TAP WATER AND RAIN WATER STORED IN THE UNDERGROUND TANK

	Tap water (p.p.m.)	Underground water (p.p.m.)
Alkalinity as $CaCO_3$	19.8	23.4
Calcium	8.2	6.8
Magnesium	1.8	0.3
Conductivity	85 m. mhos.	50 m. mhos.
pH	7.6	6.9

TABLE 3. TOTAL LENGTH, STANDARD LENGTH, WEIGHT AND NUMBER OF EGGS IN ANGELFISH

No. of fish	Total length	Standard length	Weight	No. of eggs
30	7.3 ± 0.5 cm.	5.2 ± 0.4 cm.	8.1 ± 1.6 gm.	725 ± 113

RESULTS AND DISCUSSION

(i) **Sexual Dimorphism**: There are no distinct secondary sexual differences in immature fish. INNES (1932) discussed the secondary sexual differences in this species. However, the differences mentioned by him are very slight and therefore, not helpful in distinguishing the sexes. According to our observation, the adult fish can be easily indentified. Generally the male is larger than the female. The dorsal aspect of the head of the male is more convex (*Figure 1*). In matured female, the abdomen is greatly distended. When viewed from head on, the abdomen of the female appears convex while it is concave in the male.

(ii) **Taxonomic Status of the Genus** *Pterophyllum:* This genus comprises three species (*P. eimekei* Ahl, *P. scalare* Lichtenstein and *P. altum* Pellegrin). They are all native to South America. The stock at Batu Berendam, Malacca probably belongs to *P. eimekei*. The taxonomic features like the number of spines and rays of the dorsal fin (D XI-XIII/21 – 23), anal fin (A V-VI/21 – 24), pectoral fin (11) and pelvic fin (1/5) agree with that given by STERBA (1962) for this species. However, SCHULTZ (1967) considers *P. eimekei* to be synonymous with *P. scalare*. STERBA (1962) pointed out that pure lines of Angelfish are scarcely ever found in captivity. This is due to the fact that it is easier to interbreed the hybrids than to backcross a hybrid with a pure line. In view of this, the Angelfish at Batu Berendam belongs to *P. eimekei/scalare*.

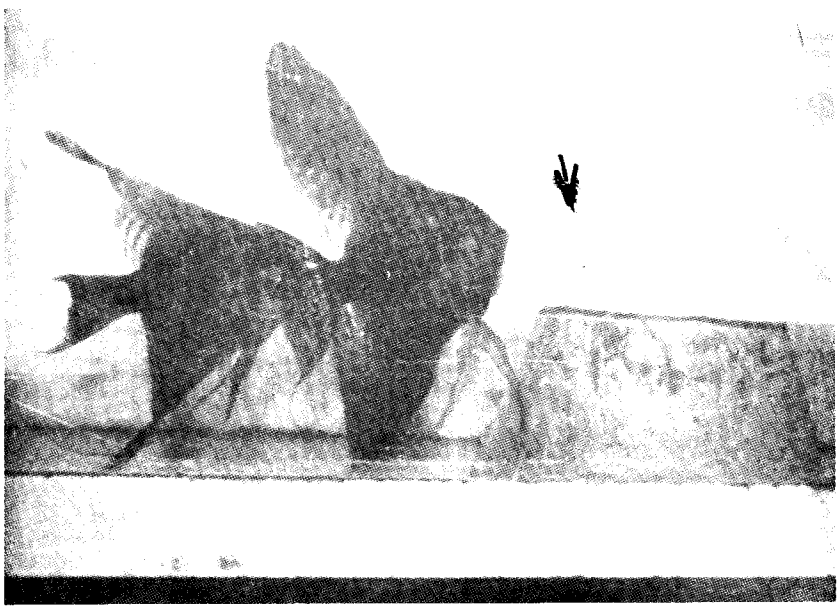

Figure 1. A pair of Black Angelfish guarding the eggs on the saucer. (Note the convex nature of the head of the male fish, the one closer to the saucer).

(iii) **Prespawning Behaviour**: The courtship and mate selection are slow and protracted. The pair first turns face to face and then with fins out-stretched makes a short, quick rush at each other and suddenly stops in time to avoid a collision. This activity lasts for some times and once the mates are chosen, the pair chooses a spawning site which is usually the latex cup/mango leaf/saucer (*Figure 1*). Sometimes they may spawn on the side of the tank or on the filter.

When kept in a community tank, the breeding pair defends the spawning site by chasing away intruders. Both fish participate in cleaning the spawning site using their lips. By this time the genital aperture of the spawning pair becomes everted to form some sort of a genital tube. The female fish has a larger genital tube (ovipositor) of about 0.4 – 0.5 cm. in length. This observation is in general agreement with that reported by MOODY (1932).

(iv) **Spawning Behaviour**: After an initial courtship display, the female fish lays batches of eggs in rows on the substratum. The eggs are fertilized by the male which swims over them. Eggs which fail to adhere to the substratum are picked up by either parent which spits them back onto the spawning substratum. During spawning the male often emits a creaking sound.

This process is repeated several times till all the eggs are laid. The parents guard the eggs if they are left under their care. However, it is advisable to transer the eggs into a basin for hatching (*Figure 1*). This would encourage the pair to spawn more frequently. When the eggs are left under parental care, spawning is less frequent and the mortality rate of the larvae is higher due to predation by the parents.

(v) **Fecundity, Incubation Period, and Survival Rate of the Larvae**: The total number of eggs per spawning, incubation period, percentage of hatching, larval survival rate and other details are given in *Table 4*. Each spawning produces between 350 and 1300 eggs. This is in agreement with the number of eggs counted from mature fish (*Table 3*). One may conclude from the data that this species lays all the mature eggs during one spawning. This is in contrast to some other tropical species such as *Betta pugnax* (CANTOR) which is a partial spawner (ANG, 1973). The number of eggs laid per spawning is much higher than earlier reported by STERBA (1962) and MCINERNY AND GERARD (1966). These authors reported that this species produces about 300 to 400 eggs per spawning.

TABLE 4. NUMBER OF EGGS PER SPAWNING, INCUBATION PERIOD, PERCENTAGE OF HATCHING, LARVAL AGE AT FREE SWIMMING AND SURVIVAL RATE OF THE LARVAE AT FREE SWIMMING IN ANGELFISH

No. eggs/ spawning	Incubation period	Percentage hatching	Free swimming	Survival rate at free swimming
825 (range 350-1300)	2-3 days	95.3 (range 93.7-96.2)	2 to 4 days after hatching	75.5 (range 53.0-95.1)

Our preliminary results have indicated that each pair, when provided with sufficient food, can spawn two to three times a month. Assuming that a female fish has a productive life-span of one to one and a half years, the estimated total number of eggs produced by a female fish in its life time will be in the region of 15,000 to 22,500.

The diurnal fluctuation in temperature seems to affect the survival rate of the larvae. This is indicated by the survival of two batches of larvae, one kept in the aquarium shed and the other in the lecture room until 1.5 months old. The larvae which were reared in the lecture room had a higher survival rate (20 – 50% higher). The variations in temperature between night and day in the aquarium shed were much greater than in the lecture room (*Table 1*).

(vi) **Larval Development**: The egg of Angelfish is creamy white in appearance and oval in shape. It measures about 0.9 - 1.1 mm. in diameter. The late stage embryo (*Figure 2*) has a large yolk-sac (1.1 mm. in diameter). The eggs are hatched within 2 - 3 days after spawning.

One-day old Larva: The larva measures about 3.2 mm. in total lenth (*Figure 3*). The yolk-sac is large. The larva lacks a mouth and fins. Pigmentation is present on the head and body. There is a well developed adhesive organ on the head. This organ helps the larvae to attach themselves to the substratum.

Two-day old Larva: The larva at this stage is 3.7 mm. in total length (*Figure 4*). The yolk-sac is reduced to about 1.0 mm. in length. The larva acquires more pigmentation on the body and head. The fleshy protuberance which will form the pectoral fins is also evident. A continuous fin-fold starts about 2/3 from the head dorsally and continued ventrally to about 1/3 from the caudal region (*Figure 4*) is also formed. The adhesive organ is still prominent.

Three-day old Larva: Three-day old larva is about 4.9 mm. in total length. The yolk-sac is further reduced to 0.9 mm. in length (*Figure 5*). The ventral side of the fin-fold moves forward to meet the yolk-sac. The oral slit is formed. The adhesive organ becomes much reduced. The pectoral fins are already formed and the last few caudal vertebrae turn upwards indicating the heterocercal origin of the caudal fin.

Four, Five and Six-day old Larva: Four-day old larva is about 5.0 mm. in total length. It is now free-swimming. The yolk-sac is much reduced or completely resorbed. It can feed on brine shrimp larvae and mashed boiled egg yolk. The pigmentation on the body

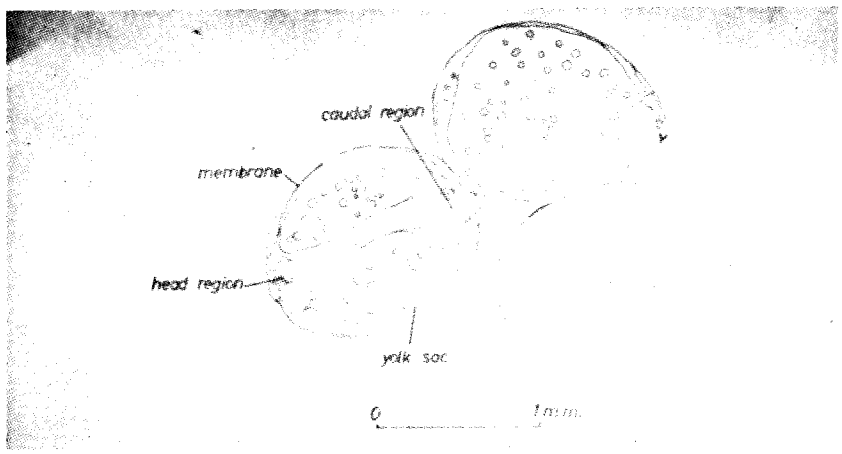

Figure 2. Late embryo stage of Angelfish.

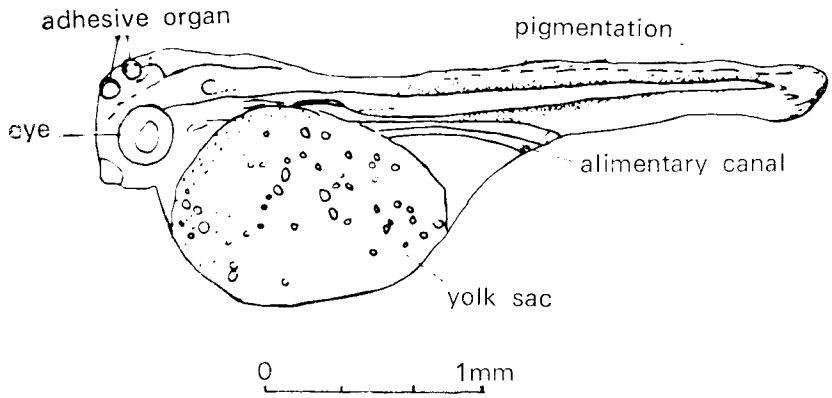

Figure 3. Angelfish: One-day old larva. (Note the adhesive organ on the head and the large yolk-sac).

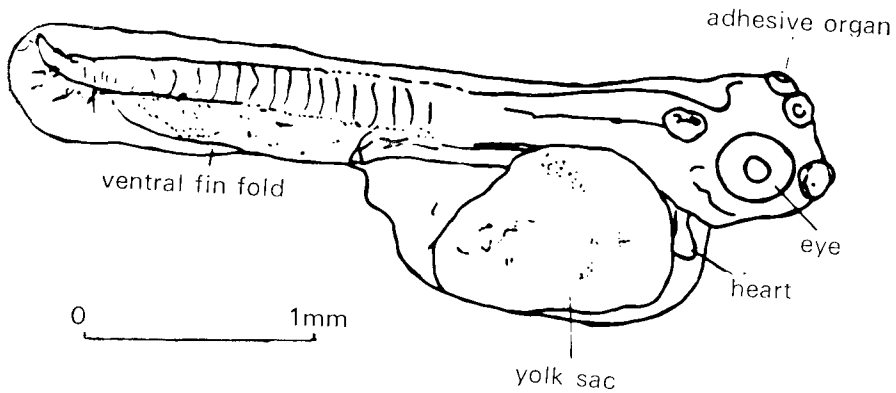

Figure 4. Angelfish: Two-day old larva.

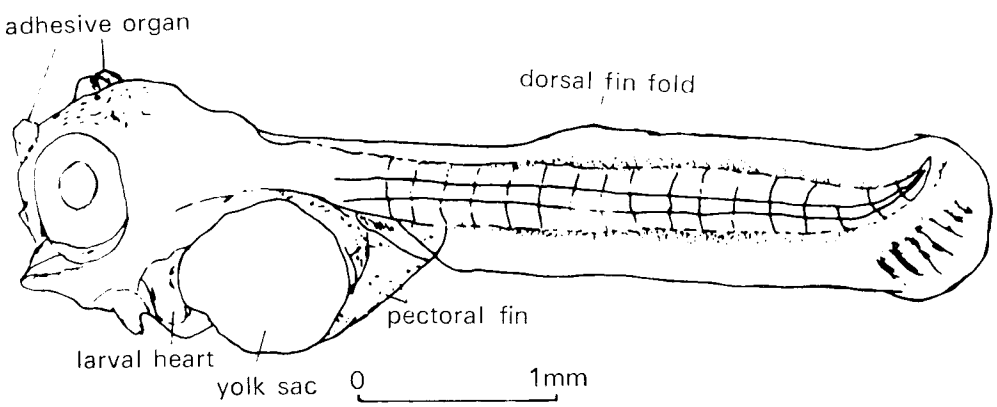

Figure 5. Angelfish: Three-day old larva. (Note the reduction in the size of the yolk-sac).

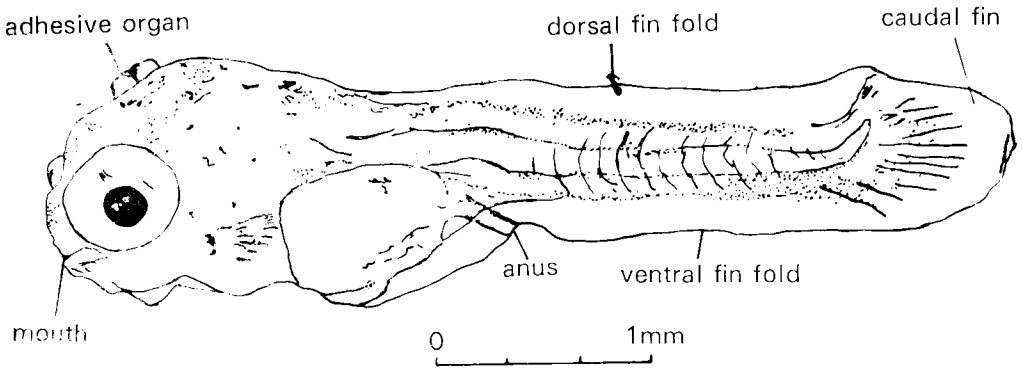

Figure 6. Angelfish: Five-day old larva.

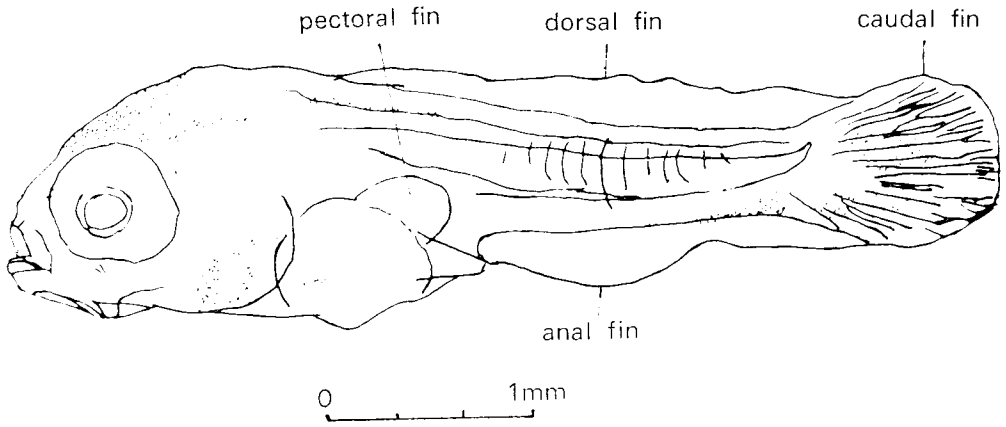

Figure 7. Angelfish: Ten-day old larva.

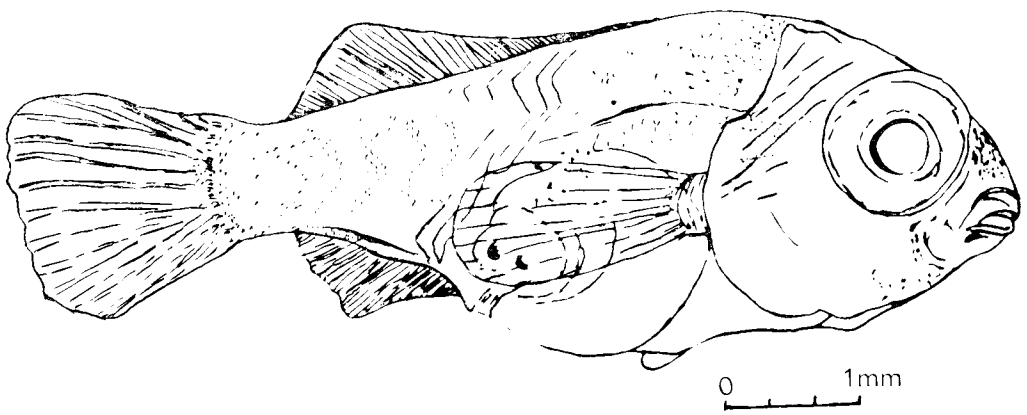

Figure 8. Angelfish: Seventeen-day old larva. (Note the general appearance of the fish which resembles the adult to a certain extent).

and head is more concentrated. Five and six-day old larvae resemble (*Figure 6*) a four-day old larva in general. The caudal fin now acquires fin rays. The pelvic fins are still absent. The larval adhesive organ has by now become rudimentary.

Seven-day old Larva: The larva is now 5.5 mm. in total length. The pelvic, anal and dorsal fins are still undifferentiated. The caudal fin has acquired pigmentation.

Ten-day old Larva: The fin rays on the pectoral fins are now visible. A fleshy protuberance which will form the pelvic fins begin to appear. The dorsal, anal and caudal fins are still continuous with the fin-fold. However, the position of the dorsal and anal fins have been indicated by the constriction of the fin-fold at definite places (*Figure 7*). The larvae are quite active. They swim in groups inside the basin.

Twelve-day old Larva: It resembles a ten-day old larva in general. It measures about 6.5 mm. in total length. Fin rays are formed on the dorsal and anal fins.

Seventeen-day old Larva: The larva is now 7.6 mm. in total length. It resembles the adult in general appearance (*Figure 8*). All the fins are formed by now. When the larva is about a month old, it resembles the adult in every respect.

(vii) A Note On The Breeding Technique And Management of Angelfish

(A) **Selection and Preparation of the Breeding Tank:** A porcelain jar, acid jar, concrete tank or the normal glass aquarium may be used as breeding tank. However, it is preferred that the tank should have one side glassed. This would facilitate easy observation during spawning. The amount of water for each breeding tank should be about 36 to 45 litres. The breeding tank should be placed in an isolated area away from extraneous disturbances.

Tap water or rain water may be used for the breeding tank. If tap water is used, the chlorine in the water should be removed by either allowing the water to stand in an open tank for at least 24 hours or by adding one crystal of photographic 'Hypo' $Na_2S_2O_3$) to every 45 litres of water.

The chemical and physical properties of the tap and rain water stored in the underground tank are given in (*Table 1*). This water is suitable for the purpose of breeding Angelfish. The pH of the water ranges from 6.9 to 8. The total alkalinity, calcium, magnesium and conductivity of the water are exceptionally low. The water temperature ranges between 26°C and 30.5°C.

(B) **Selection of the Breeding Pair:** The selection of the right pair for breeding purpose is quite a problem. Even when a true pair (*i.e.* male and female) is chosen, the pair may fail to spawn due to incompatability. Thus a suitable method is to keep all the fish in a community tank. This enables the fish to choose its own mate. Then after the pair has spawned, they may be transferred into a separate breeding tank if so desired. A suitable substratum for spawning such as latex cup/mango leaf/saucer should be provided in the breeding tank. If the fish is provided sufficient food preferably live food such

as worms, waterfleas and mosquito larvae, they will soon spawn. When the eggs are laid they may be removed from the breeding tank and transferred into a hatching basin (*Figure 1*). As a precaution against fungal infection, the eggs can be treated with Methylene Blue. The usual dosage is 10 to 15 drops of concentrated Methylene Blue to every litre of water. This chemical does not harm the eggs or larvae. After 10 to 14 days, the larvae may be transferred to a larger vessel.

(C) **Treatment of Diseases:** Angelfish is quite a hardy species. If the water is kept clean, incidence of infection of Angelfish with diseases is low. However, occasionally the fish may be infected with protozoan parasites, viral and bacterial diseases. For the treatment of fin-rot caused by bacteria, it has been found that the addition of one capsule (250 mg.) of Tetracycline to every 45 litres of water is effective in controlling the disease. The water may be changed three days after treatment.

Another infection which may be caused by Protozoan parasites is the appearance of reddish tinge around the dorsal fin. This may be treated with Methylene Blue by adding 10 – 15 drops of concentrated Methylene Blue to each litre of water or one tablet (500 mg.) of Sulphadimidine to every 45 litres of water. The water has to be changed three days after treatment if sulphur drug is used.

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SUMMARY

The breeding biology and larval development of Angelfish have been described. There are few secondary sexual differences in immature fish. In the adult, the head of the male is convex and when viewed head on, the abdomen of the male appears concave while it is convex in the female. The taxonomic status of the genus has been discussed. The spawning behaviour of this species is quite elaborate. About 350 to 1300 eggs are laid at each spawning and the eggs take about 2 to 3 days to hatch. The larvae become free swimming within 3 to 4 days. The larva resembles the adult in a period of about one month. A brief note on the breeding technique and management of Angelfish has been given.

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