



AQUACULTURE EXTENSION
Illinois - Indiana Sea Grant Program

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Fact Sheet AS-489



REPRODUCTION

Reproduction of Angelfish (Pterophyllum scalare)

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Introduction

Since the introduction of angelfish around 1911, they have held a unique position in the fish keeping world. Angelfish have been called the “kings of the aquarium,” and they are extremely beautiful animals with highly varied finnage and color schemes.

Angelfish are members of the Cichlidae family. The genus *Pterophyllun* comprises three species. The spectacular *Pterophyllun altum* (Pellegrin 1903), which can measure 13” from the tip of the dorsal to the tip of the caudal fin, is native to the upper Orinoco River basin in South America (2). The two remaining species, *P. scalare* (Liechtenstein 1823) and *P. dumerilii* (Castelnau 1855) were found throughout the Amazon basin and in the coastal rivers of the Guineas. Both *P. altum* and *P. dumerilii* are aquarists rarities. Even though *P. altum* is as attractive as *P. scalare*, both are seldom exported. The stringent water quality requirements may partially explain the limited availability of these two species compared with the widely available congener *P. scalare*,

Pterophyllun scalare is, without question, the most popular and generally more available member of the entire family Cichlidae. Both the silver and a myriad of artificially selected color and finnage varieties are commercially produced (Appendix 1) (2). These Cichlids make a magnificent solo display, but there is no practical reason for excluding other fish from their aquarium. No aggressive tank mates or, habitual fin-nippers belong in the company of any *Pterophyllun* species. Gourarnis of the genera *CoZisa* and *Trichogaster* are particularly well-suited for this role (2). The only Cichlids that can be safely housed with angelfish are festivums, discus, keyhole acaras, and most of the South American and West African dwarf species.

Unfortunately, many angelfish are purchased by neophyte aquarists whose ignorance of proper aquarium care dooms the overwhelming majority to a short and not so particularly pleasant life (2). The usual mistake entails introducing juvenile angelfish to a newly set-up aquarium. All the laterally compressed Cichlids are extremely sensitive to nitrite and un-ionized ammonia. They cannot cope with the fluctuations of these substances, which inevitably occur during the first few weeks of an aquarium’s life.

Angelfish are also one of the most magnificent species to observe spawning, and with a little experience, a producer will find it to be a very simple process. For this reason, the biological requirements and spawning techniques for *Pterophyllun scalare* will be presented in this bulletin.

Water Quality

As in any form of aquatic animal husbandry, excellent water quality should be maintained. Maintaining good water quality is as important to the ornamental fish producer using a spare room in the household as it is for the 1,000 acre catfish farm. In certain instances, it may be more difficult to provide ideal water quality requirements for a non-native fish species than for a species that evolved to fit the characteristics of its ecosystem. The water in which angelfish are naturally found is soft and slightly acidic. Angelfish will survive and grow in wide varieties of water harnesses, but for good reproduction, the producer should attempt to provide the spawners with their preferred water. Water for broodstock reproduction should be less than 80 m@ hardness and 6.8 to 7.2 pH.

Controlling water temperature is essential to angelfish reproduction. Maintain angelfish at 24 to 26° C and 26 to 28° C for spawning. Day length for angelfish should be 8 to 12 hours.

Nitrate levels should be maintained below 100 mg/l. Partial water changes are done weekly or biweekly by siphoning approximately 30 percent of the water from the bottom of the aquarium. If under-gravel filters are used, the water is siphoned from under the gravel plate (3).

Nutrition

Angelfish are omnivores. Flaked foods are readily taken by angelfish of all sizes except for fry less than one month old. Far more important to the well-being of angelfish is the proportion of fiber to protein in the diet. In nature, the food of most species comprises 50 percent to 85 percent fiber by weight, yet few food manufacturers take this into account in their formulations (2).

Most angelfish can be kept in good condition on an exclusive diet of prepared foods and may even spawn freely on such a regime. However, all do better when regularly offered live and fresh food. This is true particularly when conditioning fish for breeding. It is not the superior nutritional value of such foods as much as their superior palatability that makes them so valuable (2).

Newly hatched brine shrimp (*Artemia salina*) nauplii are essential first food for newly hatched angelfish while commercially available frozen brine shrimp are good for conditioning brooding angelfish. Brine shrimp and *Daphnia* exoskeletons rupture during freezing and the nutritional value after thawing decreases. Chironomid larvae, glassworms and krill withstand freezing well and are preferred. Ground beef heart also is used as a staple angelfish food, but it degrades water quality more rapidly than other types of feed.

Some commercial operations use supplements of fresh vegetable food to maintain the full intensity of coloration as well as general well-being. This requirement is easily met because a wide range of such foods is readily available. Romaine or other leaf lettuce varieties and spinach are particular favorites. Thinly sliced young zucchini or other marrow squashes are a superb food. These foods should be blanched by brief contact with boiling water, then cooled before being offered to the fish.

One commercial breeder (4) feeds his angelfish as many different kinds of food as possible. Live foods include shrimp, *Tubifex* worms, and mosquito larva. A variety of dried foods also are used. The higher the protein content the better. The broodstock are fed to satiation twice per day.

As soon as the fry are free-swimming, they are fed exclusively newly hatched brine shrimp, three to four times a day. Within 15 minutes after each feeding, the bottom of each aquarium is siphoned clean, and fresh water is added. This is done because live shrimp give off a tremendous amount of ammonia. The fry tank has

a clean glass bottom and no gravel of any kind. A sponge filter raised approximately 6 mm off the bottom is used. The elevated filter prevents fry from being trapped underneath the filter.

Angelfish Varieties

In the early years of angelfish production only a few varieties were available. The color patterns included the silver (wild type), black marble, black lace, and black. Special fin varieties included veil and superveil. These crosses required a long period of time to develop because most attempts at creating a new variety failed. Even with the low success, commercial breeders developed new varieties. As genetic engineering gains more importance in the ornamental fish industry, expect to see more rapid development of new varieties. Table 1 provides the crosses necessary to produce the more common angelfish varieties (6).

Spawning

The reproductive biology of Cichlids is extremely diverse and falls into two distinct categories, mouth brooders and substrate spawners. The mouth brooders incubate the fertilized eggs in the buccal cavity of female. In a few species, the male will incubate the fertilized eggs. *Oreochromis niloticus* is an example of a maternal mouth brooder. Eggs of substrate spawners are incubated in a nest. The nest may either be formed on the river or lake bottom, or in the case of angelfish, the eggs are adhesive and are laid on plants or rocks. In nature, *Pterophyllum* sp. are monogamous biparental custodial substrate spawners (3). *Pterophyllum scalare* spawns freely under aquarium conditions. The altum angelfish has infrequently but successfully bred under aquarium conditions. No spawning by *P. dumerilii* has been reported in captivity.

The prospective angelfish breeder's chief problem is identifying males and females. Angelfish are not easily sexed. Large males typically have a more rounded cranial profile than do females. Apart from this less than convincing effort to produce a nuchal hump, they are somewhat larger than their consorts, and their ventral profile from the origin of the ventrals rearward slopes sharply downwards (2). In contrast, the female's is almost flat. These distinctions are virtually useless when dealing with young adults.

The extreme lateral compression of their bodies obscures the genital papillae sufficiently to render this otherwise infallible indicator of sex quite valueless. An accurate sign of imminent spawning is the appearance of the pair's genital papillae. The genital papilla of the female usually appears first and is more noticeable because it is larger and more blunt, while that of the male is more slender and pointed. These small protuberances which appear at the vent are used respectively for depositing the eggs and fertilizing them (2).

Table 1. Required crosses to produce various angelfish varieties. Abbreviations are: Black Lace (BL), Black (B), Marble (M), Chocolate (C), Smokey (SM), Veil (V), SuperVeil (SV), Silver (S), Ghost (GH), Zebra (Z), Blushing (W).

Desired Variety	Possible Crosses			Expected Percent (%) Variety
	Female		Male	
1. Black Lace	S	X	B	100 BL
	BL	X	BL	25(S) : 50(BL) : 25(B)
	B	X	BL	50(B) : 50(BL)
2. Black	S	X	B	25(S) : 50(BL) : 25(B)
	B	X	BL	50(B) : 50(BL)
	B	X	B	100
3. Marble	M ^(a)	X	S	100
	M	X	M	100
4. Chocolate	SM	X	SM	25(S) : 50(SM) : 25(C)
5. Smokey	S	X	SM	25(S) : 50(SM) : 25(C)
	SM	X	SM	50(S) : 50(SM)
	S	X	C	100
6. Veil	Any Variety	X	V	50:5(v)
7. Super Veil	V	X	V	25(nomal): 50(V): 25(SV)
8. Zebra	Z ^(c)	X	Z ^(c)	75(2) : 25(S)
9. Ghost	BU	X	S	100 (GH)
10. Blushing	BU	X	BU	100 (BU)

- a. Marbles used in this cross must originate from a M X M.
b. The veil gene is dominant.
c. Zebras used in this cross must originate from a S X Z.

Broodstock Selection

The easiest means of securing a pair is to raise a group of fry together and allow them to pair naturally. Professional breeders do not have time to wait for the fish to pair off on their own. They select approximately 20 to 30 fish as breeders and place them in a large aquarium, preferably 208 liters (55 gallons) or larger (Figure 1). The water temperature should be approximately 27°C. Feed the fish as much live food as possible. Several slates measuring 30 cm x 10 cm are placed vertically along the walls of the aquarium. The fish pair off and attempt to breed at around ten months, give or take a couple of weeks.

Courtship will begin if the fish are of mature age. Angelfish become very territorial during this process. Courtship works both ways, with the male selecting his mate or the female selecting hers. In either case, the pair selects a territory and protects it against all intruders. Once obvious courtship has started, the pair should be transferred to a separate tank, depending on the spawning method chosen. The transfer allows the pair to be alone and prevents aggressive behavior from and toward tank mates.

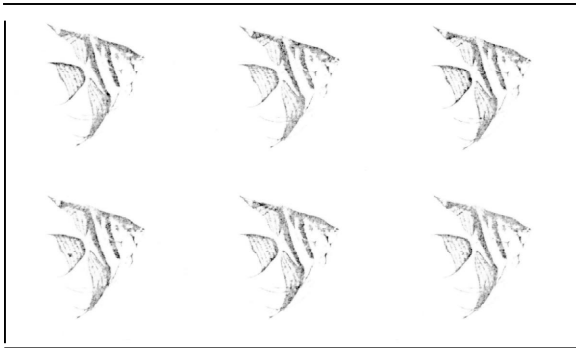


Figure 1. Broodstock selection of angelfish by stocking six age two to three month fish into 30 gal. aquarium. Spawning behavior will occur at around ten months.

Parental Spawning

Parental spawning is when the eggs are laid and parents provide parental care to the eggs and newly hatched fry until they are large enough to fend for themselves. This is an excellent method for the hobbyist who wants to observe the behavior of the parents. If one intends to allow the pair to rear their progeny undisturbed, a tank of at least 120 liter capacity is necessary to afford the fry sufficient living space. In nature, angelfish select a stout plant leaf as a spawning site. The aquarium strain of *P. scalare* will lay their eggs on any vertical surface that can be nipped clean. Usually two to three days before spawning, the pair selects and begins cleaning the spawning site, using their mouths to bite and scrub the surface of the leaf, slate, or whatever has been chosen.

After a few false passes at the site, the female passes over the site and deposits eggs, which adhere to the surface (Figure 2). The male makes alternate passes and releases spermatozoa, fertilizing the eggs. Continual movement of the angels over the eggs after the spawning serves the purpose of creating circulation through fanning movement of the pectoral fins (3).

Fish eggs usually are small (between 1.5 and 3 mm on the average) and round. Spawns numbering 500 eggs are not unusual. Egg size depends on the availability and quality of food fed to the spawners. Eggs are translucent when first laid. Infertile eggs turn white and are removed by the parents (5).

Eggs hatch in 36 to 48 hours (5). The pair chews the zygotes out of their eggshells 36 hours post-spawning. The larvae are initially shifted from one vertical resting place to another; but as they grow more active, their parents often move them to shallow pits in the substratum. The fry first attempt swimming 4 to 5 days later, but they usually require an additional day and a half to two days to become fully proficient. At this stage, they are called swim-up fry.

Young pairs often eat their first few spawns; but given time, most settle satisfactorily into parenthood. Parental care can persist up to eight weeks in captivity, but it is prudent to remove the fry from the breeding tank no later than the fourth week postspawning. By this time, most pairs show signs of wishing to respawn.

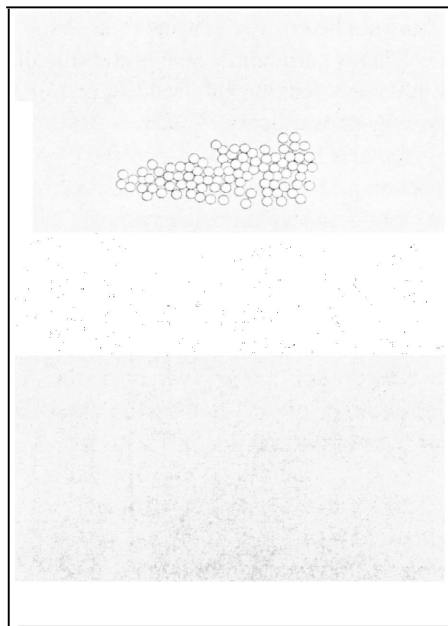


Figure 2. Slate used for angelfish substrate. The slate is 4 in. by 12 in. and 1/8 in. thick. Egg masses are represented by the white spots. A one-year old female is capable of laying 200-300 eggs every one to two weeks for a period of one year.

Egg Removal Method

The majority of the domestic angelfish are raised without parental care. The differences between parental spawning and egg removal method occur after the eggs are fertilized. Once brood fish start to exhibit courtship behavior (either the male or the female begins cleaning slate), they are transferred to a 80 liter spawning tank. The spawning tank is aerated and has two sponge filters. This interruption will affect the pair for two or three days, after which they will resume the process for breeding. After fertilization, the slate with attached eggs is placed in a 12-20 liter aquarium containing enough methylene blue to give a dark blue color. An air stone should be placed underneath the slate to provide circulation (Figure 3). After hatching, one-half of the aquarium, water should be replaced each day so by the time the fry are free-swimming the water is only slightly blue. Dead eggs should be removed each day to prevent the spread of fungus to live eggs.

When the fry are free-swimming, they should be transferred to an aerated 60 liter long aquarium at 300 fry per aquarium. The aquarium should have a water depth of approximately 15-20 cm and be filtered with a sponge filter. The shallow water depth facilitate the feeding of the fry. When the fry are approximately 15 mm in diameter, they should be transferred to a 120 to 200 liter aquarium with aeration and filtration. Fry should grow to a marketable size in six to eight weeks.

Angelfish fry are not difficult to raise provided every effort is made to keep metabolize concentrations as low as possible. If their finnage is to develop to its fullest degree, they must not be crowded during their first months of life. This is particularly true of the so-called veil strain. With heavy feeding and frequent partial water changes, the young grow quickly. Under exceptional circumstances, females begin spawning by the eighth month post-spawning. In most instances, sexual maturity is attained ten months to a year post-spawning.

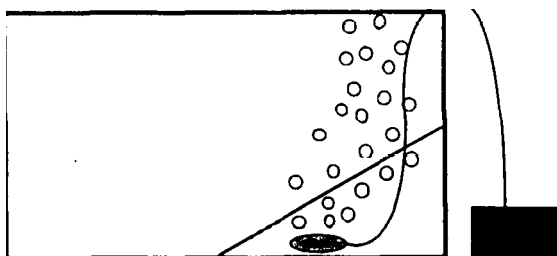


Figure 3. Hatchery tank setup. Egg covered slate is inclined against five gal. aquarium and aerated from underneath. The tank contains 1 ppm of methylene blue.

Diseases

Many disease outbreaks can be attributed to excessive parasitism complicated by secondary bacterial infections. When angelfish are purchased, they should be examined for external and internal parasites. Newly acquired fish should be strictly quarantined for at least one month before they are placed with established populations. This practice will substantially reduce the risk of introducing new pathogens to hatcheries, or home aquariums.

Two of the most commonly encountered pathogens in angelfish are *Hexamita* and *Capillana* (1). The prevalence of the enteric parasites can be reduced by periodically treating fish with metrinidazole and an anthelmintic. This is particularly important in commercial hatcheries. Treatment for other infectious agents, particularly bacterial diseases, should only be administered following identification of agents causing disease outbreaks. Sensitivity testing of bacteria is strongly encouraged to ensure proper use of antibiotics during disease outbreaks. Assistance is available from your aquaculture Extension specialist and animal disease diagnostic laboratory. Currently, the diagnosis of viral disease is hampered by the lack of a cell culture system to isolate and thereby characterize viruses of angelfish. However the structures can be observed in tissue and feces by electron microscopy, thereby permitting presumptive viral diagnosis.

Conclusions

Producing angelfish is a relatively simple procedure if a few guidelines are followed.

1. Maintain good water quality. Angelfish prefer soft and slightly acidic water, a spawning temperature of 26-28° C and 8 to 12 hours of daylight.
2. Provide high-quality feed to broodstock and newly hatched fry. The feed should consist of flake and live foods.
3. Do not overstock tanks. Use only one brooding pair per spawning tank, and do not stock more than 200 swim-up fry per 80 liter tank.

Spawning angelfish is a lot of fun for novice fish keepers and can be profitable for the more serious aquaculturists. Angelfish hatcheries can provide supplemental income to niche marketers or provide a primary income source for large-scale hatcheries that sell angelfish to wholesalers.

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Appendix

Several *Pterophyllum scalare* varieties are available from Exotic Angels, West Lafayette, Indiana.

Prices are 20 to 25 mm diameter fish unless other wise noted.

Prices quoted were for 1992.

Ghost Standard	\$2.00	Marble Pearl Scale	\$7.50
Ghost Veil	2.00	Marble Pears Scale	
Silver Standard	2.00	Standard	6.00
Silver Veil	2.50	Marble Pearl Scale	
Gold Standard	3.00	Veil	7.00
Gold Veil	4.00	Black Standard	6.00
Marbel Standard	4.00	Black Veil	7.50
Marble Veil	4.40	Black Lace	5.00
Gold Marble Standard	4.00	Black Blusher	8.00
Gold Marble Veil	4.50		
Chocolate Standard	5.00		
Chocolate Veil	5.50	Medium	
Chocolate Blusher Veil	6.50	White Blusher	12.00
Chocolate Blushing Pearl		German Blue Blusher	12.00
Scale Standard	6.50	Gold Pearl Scale	20.00
Chocolate Blushing Pearl		Black Veil	25.00
Scale Veil	7.00	Black Blushers	25.00
White Blusher Standard	5.50		
White Blusher Veil	6.50	Adult (breeder size)	
White Blushing Pearl		Silver Veil	30.00
Scale Standard	7.00	Gold Veil	40.00
Koi Standard	5.50	Chocolate Veil	45.00
Koi Veil	6.00	Black Lace Veil	45.00
Gold Pearl		Black Standard	45.00
Scale Standard	6.00	Black Veil	55.00
Gold Blushing Pearl			
Scale Standard	7.00	Breeder Pairs	\$125.-175
Gold Blushing Pearl			
Scale Veil	7.50		



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