Breeding *Awaous (Euctenogobius) flavus*

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When developing a method of rearing the larvae of any fish species for the first time, special consideration must be placed in providing sufficient food and an appropriate environment. In the case of *Awaous (Euctenogobius) flavus*, an amphidromous goby, both of these considerations provide an interesting challenge for the aquarist attempting to raise them.

Amphidromy

In order to define the word "amphidromy" I will first define several related words. Diadromy refers to a regular migration pattern between fresh and salt water. Anadromy, catadromy, and amphidromy are all forms of diadromy. Anadromy refers to the migration patterns of fish, such as salmon, that live in the ocean but return to fresh water to spawn. Catadromy refers to the migration patterns of fish, such as certain eels, that live in fresh water but return to the sea to spawn. In amphidromy, the migrations are not directly tied to spawning, but to some other activity, such as feeding.

Many gobies, including the genera *Awaous*, *Sicydium*, and others, have an amphidromous lifecycle. There are two migrations. The extremely tiny larvae hatch in fresh water and drift passively with the river currents to estuaries or the ocean, where they develop for some time, typically a few weeks or months, before migrating back to the freshwater rivers. Here in freshwater the juveniles continue to feed and grow, mature, spawn, and live the rest of their lives.

The Quest to Rear *Awaous flavus*

Coming from the deeper sections of large rivers with Atlantic drainage in northern South America, *A. flavus* is probably the most popular of the amphidromous gobies within the aquarium hobby. Aquarists frequently identify them as them as *A. strigatus* or *A. badius*, however these names are synonyms of *A. flavus*. Popular common names for the fish include striated river goby, candy stripe goby, and Brazilian pinstripe goby.

To my knowledge, the larvae have never been successfully reared in captivity. Most of the difficulty is in providing a steady source of a sufficiently tiny, nutritious, and attractive food. It is not known what the larvae feed on in the wild, nor is it known exactly what length of time the larvae spend at sea.

I first set out to raise *A. flavus* in the summer of 1998, in the basement of my home. Having worked on the project intermittently for 2 1/2 years, I began in earnest in January of 2001.

The fish were bred in a 30 gallon single species freshwater aquarium with a sandy substrate. They were fed a variety of live, dry and frozen food. When possible, four females were housed with two males.

Courtship, Spawning, and Hatching

My early observations were of courtship, spawning, and egg hatching. The male's courtship behavior includes an impressive display, consisting of widely spread fins, lateral display, and a mouth gaping to one side. His body and fins become a very deep black, while his dorsal fin takes on fiery orange markings. The female, if receptive, also opens her mouth. Her body coloration pales, but her eyes and fins take on a darker appearance.

The male encourages the female into his selected spawning cave, such as a coconut shell half pressed into the sand with a small flat entrance cut near the bottom. The fish usually remain in the cave for several hours and spawn. When spawning is completed, the entire inside of the cave is covered in a thin layer of eggs. The male alone is responsible for broodcare. After the female leaves, the male sometimes seals up the entrance of the spawning cave with sand and remains inside the cave to fan the eggs. At other times the male may leave the nest of eggs briefly.

The females usually spawn every one to three weeks, but the males will spawn daily if given the opportunity. Older females, however, spawn less often and produce significantly fewer eggs. In my experience (about 40 spawns), with only one exception, spawning has taken place in the late morning or midday.

The eggs hatch in approximately 12 1/2 hours, which is typical of amphidromous gobies. The very undeveloped prolarvae are about 1.1 mm TL (total length) and drift in a vertical position throughout the midwater. They drift head down but occasionally swim upwards to maintain their general position in the water column. By calculating the volume of water in the tank and counting the larvae in a few square inches of water, I estimated that the number of larvae is about 10,000 per spawn.

Just after hatching, the larvae appear to be little more than a large blotchy yolk sac and tail, when viewed under a low power microscope. The eyes are not pigmented and the larvae are not yet capable of feeding. Twelve hours later the yolk sac is smaller and rounder, and a tiny beating heart is clearly visible. The larvae grow rapidly for the first few days, living off the yolk sac.

It takes about 100-108 hours (between 4 and 5 days) before the larvae begin to take on a horizontal position. At this point the larvae are 1.7 mm long and have fully pigmented eyes. It is soon after this point that the larvae are ready to feed.

What Salinity is Needed For Rearing?

Early in 2001, I began a series of experiments to find out an appropriate salinity and method of transfer for the larvae. This necessitated that I set up a number of separate rearing tanks.

After each spawn, I siphoned larvae from the breeder's tank into up to four 5 1/2 and 10 gallon aquariums. The temperature was kept the same as the breeders' tank, about 79 degrees. A simple drip system was designed to add freshly mixed salt water (Instant Ocean) to the rearing tanks. The following were my results:

Three trials in which no salt water was added to the rearing tanks resulted in 100% loss after 48 hours.

Three trials in which the specific gravity was raised to 1.010 over a period of 12 hours resulted in 100% loss after 108 hours (about the time the larvae would normally begin to take on a horizontal position).

Additional trials in which the specific gravity was raised to 1.018 over a period of twelve hours resulted in a significant number of larvae living beyond 108 hours. I noticed no increase in survival when the specific gravity was further raised to 1.024.

After this point all my rearing experiments were done with the specific gravity raised to 1.018. In later work I no longer used the drip system but simply dumped in salt water by the cupful, and found that the larvae tolerated such treatment.

Attempts at Feeding

Having found that transferring the larvae to a higher salinity was not a difficult problem (and, as I later found out, Hans Horsthemke in Germany had already done this),I set out to find a suitable food.

Many possible foods were tried, from strained egg yolk to infusoria to yeast, with generally poor results. Occasionally larvae lived 10-12 days and appeared to be feeding; however the larvae almost always had empty digestive tracts when examined microscopically.

The most promising results occurred when I offered the larvae rotifers (Brachionus) that were being raised directly in the rearing tanks. The tank was lighted for 14 hours from above and covered with black paper on the sides. (Black paper helps many species of planktonic larvae orient themselves.) On Day 1 mixed microalgae were introduced to the tank to feed the rotifers. On Day 2 a very small number of rotifers was added to the tank in hopes that they would reproduce and provide young that were tiny enough to fit in the mouths of the goby larvae. (Five-day old larvae, minus the tail, are approximately two times the size of the adult rotifers.) By the time the larvae were ready to feed (Day 5) there was a modest but steadily growing population of rotifers. Microalgae were added each day to keep the rotifer population growing, and twenty percent of the water was changed three times a week. I found it almost impossible to siphon the water through a hose without losing some of the larvae, so I used a length of airline tubing with an airstone attached to the intake to prevent any larvae from passing through.

Over the next few days many of the larvae I examined had something in their digestive tract. I was not able to tell what they were feeding on, however I suspect their diet was a combination of newly hatched rotifers and unidentified ciliates (presumably a contaminant of the rotifer culture). Beginning on Day 9, the lighting was left on for 24 hours a day.

By Day 18 the larvae measured almost 2.4 mm TL and had large shiny eyes, discernable even without the aid of a microscope. Unfortunately, all of the larvae were dead by the end of Day 20. My best guess is that rotifer overpopulation was the cause of their demise.

Conclusion

I highly encourage other hobbyists to try their hand at rearing this and other "challenging" species. It is not rocket science! All it really takes to become an experimental breeder is patience and determination. The only reason many species have not yet been successfully reared is that too few people have tried.

female on left

male on right

all photos by Naomi Delventhal