

## Small-Scale Guppy Breeding<sup>1</sup>

by Diana Walstad  
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Guppy breeding appears to be a daunting business—a fish room full of tanks, massive water changes, and buying brine shrimp eggs by the pound. Here, I propose a low-key approach.

From the beginning, I limited myself to 8 tanks and less than 100 gal of water. I could expand in the summer with 4 outdoor tubs, but that was it. Furthermore, I scheduled my time for tank maintenance to a couple afternoon hours. Otherwise, I could easily see “tank tinkering” becoming an all-day affair.

### Modern Guppies

There was a time when the Guppy (*Poecilia reticulata*) was the gateway fish for beginners and children. In the 1950s Guppies were beloved for their hardiness, ease-of-care, and pretty colors. They didn't require large tanks, special water conditions, massive water changes, etc. Unlike other aquarium fish, Guppies could produce offspring with a riotous—and often unexpected—variety of colors and patterns. Breeding Guppies was exciting and creative.

However in the last few decades, the common Guppy is no longer the easy-keeper it once was. Many hobbyists—and not just beginners—find it difficult to keep purchased Guppies alive more than a month or two. While there is currently no single explanation [1], the Guppy has now undergone decades of captive breeding, much of it designed to meet standards for designated strains. Breeders—whether commercial or advanced hobbyists—strive to perfect the physical beauty of their strains, whether it be body shape, size, finnage or color patterns. Show standards and competition encourage breeders to meet artificial beauty standards that may not hold up in the real world. No awards are given for longevity and disease resistance [Fig 1].

Commercial guppy breeding also focuses on meeting defined standards of uniformity. Asian guppy farms fulfill retail store requirements for so many Half-black Blues, so many Sunset guppies, etc. They use inbreeding/line-breeding to counteract the Guppy's natural polymorphism and tendency to revert to its wild coloration. Fancy Guppies are now highly inbred compared to their wild brethren [2]. Guppy inbreeding inevitably results in some loss of vigor, longevity, and fitness [3, 4].

Moreover in nature, Guppies must contend with a wide variety of pathogens. There is a constant Darwinian selection for disease resistance. In contrast, domestic Guppies have been bred for generations in a sheltered environment and lost much of the wild Guppy's disease resistance. For example, investigators [5] showed that two wild Guppy populations had 15-16 key MHC genes for immunity, while three fancy strains had only 1-3.

In summary, generations of captive breeding have produced an increasingly fragile Guppy.



**Fig 1 Show Winner [6]**

These beautiful Half-black Blues have met the standards of the IFGA (International Fancy Guppy Assoc.).

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## Purchasing Guppies

Every purchase entails some risk, whether the risk be from disease or poor genetic makeup. The cheapest fish offered on the Internet may be inferior fish produced by breeders who do no selective breeding. Experienced breeders who cull out weak, poorly colored, or deformed specimens from their breeding stock generally charge more.

Surprisingly, I have had good luck with store-bought *male* Guppies. Often, they have the iridescent colors that many fancier Guppies do not have and they pass those colors on to their young. In contrast, with the female Guppies offered in stores, one can only guess at their genetic makeup. The few times that I have bred them, their progeny was disappointing; their coloration did not approach that of the store-bought males.

The imported Guppies sold in stores have a reputation for fragility, but it may not be deserved. Generally, Southeast Asian farmers raise commercial Guppies under healthy conditions [1]. The fish start out their long export journey relatively disease-free, but become severely stressed from the shipping process. Once in retail stores, they may receive poor care and are suddenly exposed to opportunistic pathogens for which they have no disease resistance. Thus, I seek out stores where fish are well-cared for by conscientious and knowledgeable staff. Once home, I quarantine and coddle them the first week or two.

Many hobbyists are justifiably put off by the modern Guppy's fragility. Options to consider are obtaining feral Guppies, wild Guppies or even feeder Guppies [Figs 2, 3, 4]. All of these Guppies are more disease resistant than their fancier, domesticated brethren. Males can be crossed with fancy, inbred females to increase disease resistance. Another option is seeking out Guppy breeders that have not neglected disease resistance in their breeding program.

Some hobbyists have chosen to keep Endlers, but I prefer the big size, delta tails, sail-fin dorsals, and greater docility of the Guppy. Fish keepers—with a little knowledge—should be able to raise Guppies that are not only fancy but vigorous and disease-resistant. This article explains how I do it.



**Fig 3 Wild Guppies** [8] from Trinidad, South America



**Fig 2 Feral Guppies** [7] from a WV hot-springs are descendants of wild-type and domestic Guppy strains. They have largely reverted back to their wild origins with clear fins and iridescent color patches.



**Fig 4 Feeder Guppy** [9] This colorful male rescued from a tank of feeder Guppies shows the iridescent patches of wild Guppies. He was mated to fancy Guppies to increase their iridescence and disease resistance.

### Tank Setup with Plants

Assuredly, live plants are not necessary for breeding Guppies. Most Guppy breeders rely on water changes, aerators, and filters to purify the tank water. Tanks that are equipped with good biological filtration and maintained according to established norms work just fine.

I use fast-growing plants in all my setups to purify the water [Fig 5]. I depend on them to remove ammonia and other waste products. Thus, I can feed the fish well without using filters and doing massive water changes.<sup>2</sup>

Plants are either floaters or grown in pots that I can easily pull out of the tank before catching the fish. I do not use a typical gravel substrate. Plants won't grow in it, plus it will collect debris, become anaerobic, and release toxins.

I use gentle air bubbling to circulate water in the tanks. Bubbles are released from a glass tube connected with regular airline tubing to a small air pump. Large air-bubbles (not fizz from an air-stone) come out of the glass tubes at about ~30 bubbles



**Fig 5 Guppy Tanks** (5 and 10 gals) contain plants in pots. I use inexpensive 36" LED lamps that span over two tanks.



**Fig 6 Summer Tubs** Each tub holds about 12 gal and receives shaded sunlight. Water temperatures range from about 62°F to 78°F. Tubs are inexpensive storage containers from hardware stores. I cover them at night with plastic sheeting to keep heat in and raccoons out.

per minute. Excessive bubbling is not necessary and will stunt plant growth via CO<sub>2</sub> degassing.

For potting plants, I only use a clay garden soil. (I would not use potting and other organic soils, because when confined within a pot, they can go severely anaerobic and kill plant roots.) I cover the soil with a little aquarium gravel.

For plant beginners, I suggest starting with summer tubs [Fig 6]. They are easy to work with and don't require artificial lighting. I don't use any aeration or water circulation in the tubs.

### Maintenance and Stocking Densities

General tank maintenance for me includes siphoning mulm from the bottom, thinning out excess Guppies, trimming and repotting plants, removing mat algae, changing water, etc. I change about 10-20% of the water in each tank or tub every 2-6 weeks.

Many expert Guppy breeders advise fish breeders to do massive water changes. Indeed, continuous flow systems will automatically prevent many potential problems—ammonia, toxins, disease, etc. Some Discuss breeders report getting markedly faster growth of their juveniles with daily 50% water changes.

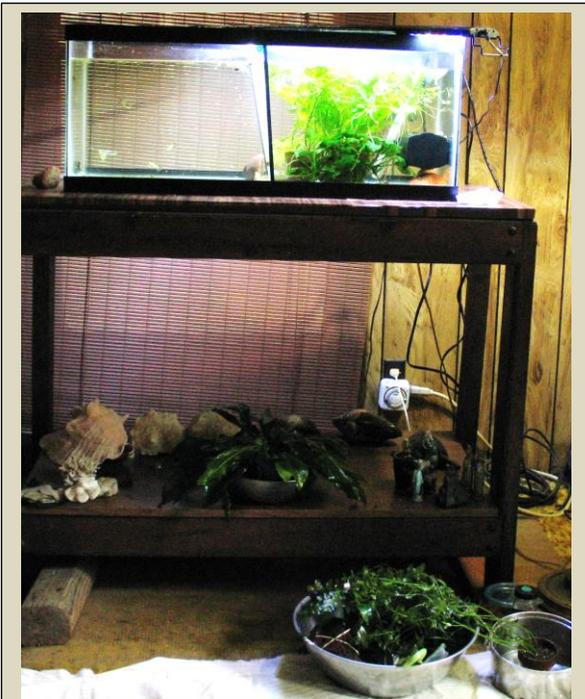
<sup>2</sup> I explain this strategy thoroughly in *Ecology of the Planted Aquarium*.

However, large-scale fish breeders generally stock their tanks with many more fish than I do, plus they don't use plants for water purification. My Guppies are healthy and grow out within a respectable 2-3 months of age. Thus, arguments for frequent water changes just have not registered with me.

I keep my tanks lightly stocked. My comfort zone for a 10 gal is 40-60 baby Guppies, 20-25 juveniles (1" and 2-3 mos. old), and 3-5 full-grown Guppies (2" and 6-12 mos. old).

With a new Guppy pairing, I keep only ~20 fry from the female and raise them up by themselves. Twenty individuals is usually enough to tell me if the pairing was successful or not. With some pairings, I might start with a batch of 40-60 babies and later thin it down to 20-25 fish. I avoid mixing fry from different batches. It's just too hard to follow the genetics, identify superior individuals, etc.

Breeding Guppies, frankly, requires considerable fish catching, a task that would be well-nigh impossible in the typical planted tank. All plants in my Guppy tanks are portable (**Fig 7**).



**Fig 7** **Catching Fish** is made easier because all plants are "portable." Here, I have temporarily transferred half the plants from this 20 gal tank to metal pans below. Because the adult Guppies are so tame, they can stay in the tank while I catch the fry.

I carefully monitor fish health by observing behavior. If the Guppies start acting strangely and not eating, I take corrective action. A couple times now, the problem has stemmed from cheap submersible heaters that apparently released plastic-type toxins into the water. (I had to remove the fish, employ charcoal filtration, and buy better quality heaters.)

My male Guppies begin showing color around 2 months; female start having babies at 2-3 months. This "grow-out time" jives with those raised in Southeast Asia that are exported for sale at 75-120 days [1]. Hobbyists can use the grow-out time of their own guppies to gauge the efficacy of their fish-rearing system (fishfood, water changes, stocking density, etc). That said, some people do not mind if it takes a couple extra months to raise their guppies.

### **Euthanasia**

To breed Guppies, one must routinely remove and euthanize fish. Healthy, well-fed females produce ~50 babies every 3-4 weeks. Mine don't eat their fry. One cannot possibly raise every single fry born. Nor should one keep sickly and deformed Guppies in a breeding colony.

I would argue against putting unwanted fish in the freezer or down the toilet to a lingering death. I use 100% clove oil, which is inexpensive and widely available. I collect all unwanted Guppies and put them into a dark container with about 2 cups of their tank water. Then, I add 2 drops of the clove oil and cover the container. The clove oil gently puts small fish like Guppies to sleep and then kills them in about 5-10 minutes. (Guppies can be resuscitated from the sedated state with no ill effects if rescued quickly enough.) Afterwards, I scatter the container contents in a forested area of my property; the fish fertilize the trees.

## Foods

Guppies are omnivores, so I include vegetable-type pellets in their diet. Pellets are generally better than flake food [10]. Vitamins degrade, so I store bulk stocks of food in the refrigerator/freezer and portion out enough for 2-4 weeks of feeding. Treats include freeze-dried bloodworms, hard-boiled egg yolk, and a homemade food paste. I try to adhere to a daily feeding schedule starting with flake food at 8 AM. Fish get fed 2-3 times a day.

One can raise and breed Guppies without hatching brine shrimp eggs, but young fish will not grow nearly as fast. I feed baby Guppies live baby brine shrimp twice a day for the first two weeks.<sup>3</sup> I don't flood tanks with the shrimp, because that could cause a population explosion of nuisance hydra. Baby and young Guppies will hunt down the last live shrimp until their bellies are properly swollen.

Baby and juvenile Guppies will grow faster with a protein-rich diet. Ditto for females; they need protein-rich food to produce 25-80 babies every 3-4 weeks. Adult males may be more vulnerable to a rich diet. Males from one of my guppy strains tend to swell up morbidly at around 6 months. While they live longer with a more restricted diet (e.g., flake food once per day), some guppy experts view these fish as genetically flawed and do not keep them for breeding.

## Stress Reduction

Guppies are social fish and have personalities. Juveniles, in particular, like to be in groups. In pairing up breeders, I keep 2 females with each male even if I only need one female. Some males can be overly zealous and/or pick on one particular female. If I see continuous bullying in the tank, I pull the bully out. Bullying causes stress and stress can lead to poor growth, disease, and death.

When newly purchased fish are not eating, I sometimes add one of my homebred Guppies to make them less fearful. Feeding them live baby brine shrimp also helps. Older adult Guppies will go after brine shrimp as eagerly as fry. It keeps them occupied and stops their fretting.

I am careful when netting older breeder Guppies. Males with their big delta tails can be injured and get bent backs by rough handling. I use soft mesh nets only, as opposed to nylon nets which might scrape their skins. Sometimes I can gently coax a net-trapped individual into a cup using my hand. Transfers don't need to be traumatic.

Fortunately, Guppies are thoroughly domesticated and accustomed to being handled. I move mine around directly from one tank to the other. Generally, they will settle down by the next feeding time.

## Diseases

After 100+ years of captive breeding, common Guppies have lost much of their original hardiness. They have become increasingly disease susceptible [1, 5].

In 2017, I started buying Guppies from breeders (via the Internet) and imported Guppies from the pet shops. I knew that disease would be a major hurdle. Most of the new fish were healthy, but it only takes a couple afflicted individuals to wreak havoc. Unsurprisingly, it was not long before some fish became diseased. The parasites *Camallanus* worms and skin flukes caused me the most problems.<sup>4</sup>

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<sup>3</sup> See my website (<http://dianawalstad.com>) for article 'Hatching and Growing Brine Shrimp.' I grow the shrimp out for a few days before feeding them to the fish. An easier method used by some Guppy breeders is to hatch out large quantities of eggs and store the resulting *nauplii* in the refrigerator for a week of feeding.

<sup>4</sup> Eventually, I eradicated these pests using fenbendazole for the *Camallanus* worms and levamisole (and/or salt) for the flukes. I describe how I did it in two separate articles on my website.

After eradicating these parasites, I realized that one does not have to become a disease expert to keep Guppies healthy. Many major Guppy pathogens are external, opportunistic parasites (flukes, Costia, Ich, Tetrahymena) that can be killed by ordinary table salt.<sup>5</sup> Guppies that slowly develop shrunken bellies probably have “Fish TB,” the most common bacterial disease. Since it is incurable and somewhat contagious, the afflicted individual should be removed and destroyed.

Most diseases are caused by organisms that are part of the fish’s natural environment, which includes the fish’s gut. Ordinarily these opportunistic pathogens are not a problem, because the fish’s immune system keeps them under control, thereby preventing disease. However, modern Guppies have lost much of the wild Guppy’s natural immunity.

Diseased individuals should be removed from the tank as soon as possible. A diseased fish is a reservoir of activated pathogens. Allowing a sick fish to die in the tank is a very bad idea. As it decomposes, it releases astronomical numbers of the pathogen, now with enhanced virulence, into the tank. Small numbers of potential pathogens like Ich or mycobacteria may be harmless; large numbers can cause disease. Numbers count!

Whenever possible, I let tanks rest a few days without fish. [Many parasite larva (e.g., Ich, skin flukes, etc) will die if they are unable to latch onto a fish within a few days of hatching from their cysts.]

I keep incoming Guppies by themselves for the first 1-2 weeks. At the first sign of problems (clamped fins, not eating, etc), I’ll put them into a small tank with 0.9% saltwater for 3-4 days. While hospitalized, they get fed live baby brine shrimp. More often than not, the fish recover within 1-2 days.

Similarly, I like to put a potentially sick fish into a ~0.7% salt bath (1 tsp table salt per quart of tank water) for 30 min. This mild treatment—very convenient to use when transferring fish to a new tank—won’t hurt juvenile and adult Guppies, but it is strong enough to reduce the fish’s parasite and bacteria load. A quick “salt bath” gives a stressed and weakened fish a better chance of *not* getting sick.

I don’t mind coddling fish that have been weakened by shipping, bullying, accidents, etc. However, there came a time when I was unwilling to rescue every single sick Guppy, especially those that I had raised myself and that were well-established. I decided that heroic measures were counter-productive. Diseased individuals not only threatened the other Guppies but perpetuated genetic fragility.

One particular strain of Guppies, the Metalheads, developed notably more disease than my other strains [Fig 8]. When the tank had a fluke outbreak, the Metalheads were the first ones to get sick. Indeed, they may have caused the outbreak. Other strains did not get sick or fared much better with disease treatment. Eventually, I got rid of the Metalheads. They were just not worth the trouble.

Now, I have fish that are healthy and relatively trouble-free. Disease is a rarity. I can concentrate on the fun stuff—breeding and genetics. I can trade, sell and share my Guppies without qualms.



**Fig 8 Metalhead Males** were beautiful but too fragile for my tanks.

<sup>5</sup> My website article ‘Parasite Surveys of Aquarium Fish’ shows the salt susceptibility of parasites associated with Guppies and other tropical fish. Multiple surveys have shown that parasites—not bacteria or viruses—cause the majority of disease problems in the aquarium fish industry.

## Keeping Records



**Fig 9 Pictorial Records** This photo shows a pair of 10-week-old BG (Blue Grass) Guppies shortly after purchase.

I keep a journal of every pairing, birth date, death, etc. Every month I inventory each tank. With these records, I can predict when breeder females will be delivering their next batch, how fast their fry are growing, etc. Sometimes it helps just to write down *why* I am pairing certain Guppies together.

Pictorial records turned out to be invaluable. Fully grown BG (Blue Grass) males and females take months to develop their big delta tails and high dorsals. Using

early pictures [Fig 9] of young BG males and females helped me select the best potential breeders from their progeny.

## Reproductive Factors

After mating, the female Guppy stores sperm. About 1-5 days after giving birth, sperm is released from internal storage sites to fertilize eggs for her next batch of babies. Guppies can produce batches from stored sperm for 8 months without a male present [3]. If multiple males are present, she will likely produce mixed batches. One study [11] reported 1-9 sires per batch (average was 3.5).

While determining paternity is not always straight-forward, fresh sperm generally wins out over older sperm.

Guppy breeders [3] conducted multiple experiments where gold females were first mated to gold males. Weeks later as the females were giving birth to golden fry, gray males were added to the tank. The next batch of fry were all grays. The experiment was repeated with albino females plus gray males yielding identical results. (Gray, the natural guppy color, is genetically dominant over both the gold color and albinism.) Recently (2018) investigators [12], using artificial insemination of females, showed that virtually all offspring were from the most recent insemination, not earlier ones.

After pairing a female with a desired male, I discard the female's first batch and keep only later batches. This "wait a month" policy has worked reliably for me except in one peculiar instance. BG females mated to their sibling BG males produced mixed batches of babies 2-3 months after being kept with HB (Half-black) Blue males [Fig 10]. I now suspect that these mixed batches (containing both BG and HB fry) represent a Guppy "inbreeding avoidance mechanism"<sup>6</sup> The HB-BG mating was an out-cross, while the BG-BG mating represented inbreeding. Because of this mechanism, the fresher BG sperm was unable to completely supersede the older HB sperm.

Many breeders sex their Guppies when they are a few weeks old and put males and females in separate tanks. However, I found this procedure tedious. Plus, I am unwilling to devote two tanks for each batch. I just let siblings grow up together and then pair up breeders at a later time.



**Fig 10 Pairing** of BG females and HB (Half-black) Blue males produced some interesting results.

<sup>6</sup> Guppies counteract inbreeding with a variety of behavioral and physiological mechanisms. For example, investigators artificially inseminated females with a 50:50 mix of sperm from full-sibling males and less-related males. They showed that females produced significantly less fry from the closely related males [13].

I put a priority on older Guppies for breeding. This helps select genes for longevity and other fitness traits. For if one uses only young Guppies for breeding, one inadvertently selects for a shorter life-span than the typical 1-3 years.

### Discussion

One can keep assorted male Guppies in a tank and enjoy them just like any other tropical fish. Breeding them is far more work. There are so many beautiful strains, so many genetic possibilities. It is hard not to keep oneself from being overrun by fish and tanks!

Seasoned Guppy breeders, not just beginning hobbyists, encounter disease problems. Breeding Guppies became doable for me only after I addressed disease problems in newly purchased Guppies via quarantine and treatment. Afterwards, I methodically eliminated sickly, disease-susceptible fish from the gene pool. Outcrossing to disease-resistant strains was the fastest way to bolster fragile, inbred strains. The Guppies that I am raising now rarely get sick.

Overall, Guppy breeding can bring a new and unexpected dimension to keeping aquarium fish. A single female Guppy, assuming that she is not from a “fixed” inbred strain, will produce a kaleidoscope of colors and patterns. Indeed, the common Guppy is the darling of scientists studying fish ecology, evolution, and behavior. In a future article, I will discuss my experience with Guppy genetics.

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Diana Walstad is the author of *Ecology of the Planted Aquarium* (2013). For more articles and information about her book, see: <http://dianawalstad.com>.