Guppy Color Bank

Philip Shaddock

First Edition
March 2008

Contents

1 Guppy Color System

What we see is not necessarily what we get when it comes to guppy colors. Examination under a microscope reveals that the color cells form a very fine system of dots, just like the dots on a TV screen or a computer monitor. This picture shows an area of guppy skin as seen under a microscope:

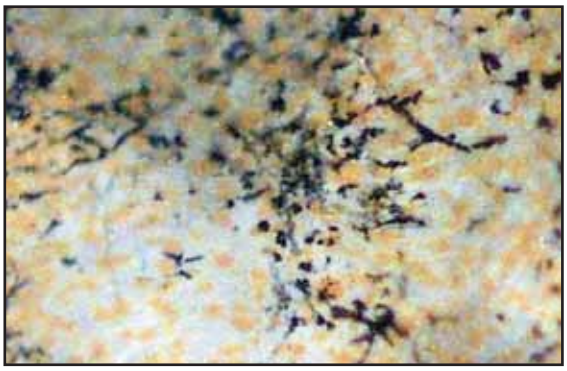


Fig. 1 Guppy color cell showing yellow and black color cells.

There are also light-reflecting iridophores. Seen from a distance, the yellow, white light-reflecting and black color cells appear to merge into grey.

Color cells are layered. Fig. 2 by Dr. José René Meléndez Berríos, guppy breeder and surgeon, shows a transverse section through the peduncle of a blond red guppy.

You can see the layered arrangement of red and yellow color cells in the epidermis of the guppy's skin. Color cells in the guppy are not two-dimensional. They exist in three-dimensions.

Fig. 2 Cross-section of the guppy skin.

The Four Classes of Color Cells

The layers contain four classes of color cells that combine to produce the thousands of colors of the guppy and other fish.

- **Erythrophores** or red color cells
- **Xanthophores** or yellow color cells
- **Iridophores** or light reflecting color cells
- **Melanophores** or black color cells

The color cells are arranged in three basic layers (Fig. 3). The graphic shows the way light strikes and penetrates the three layers.

- The bottom **Absorbing Layer** absorbs all sunlight, preventing damage to internal organs from the sun's rays. It also absorbs scattered light rays

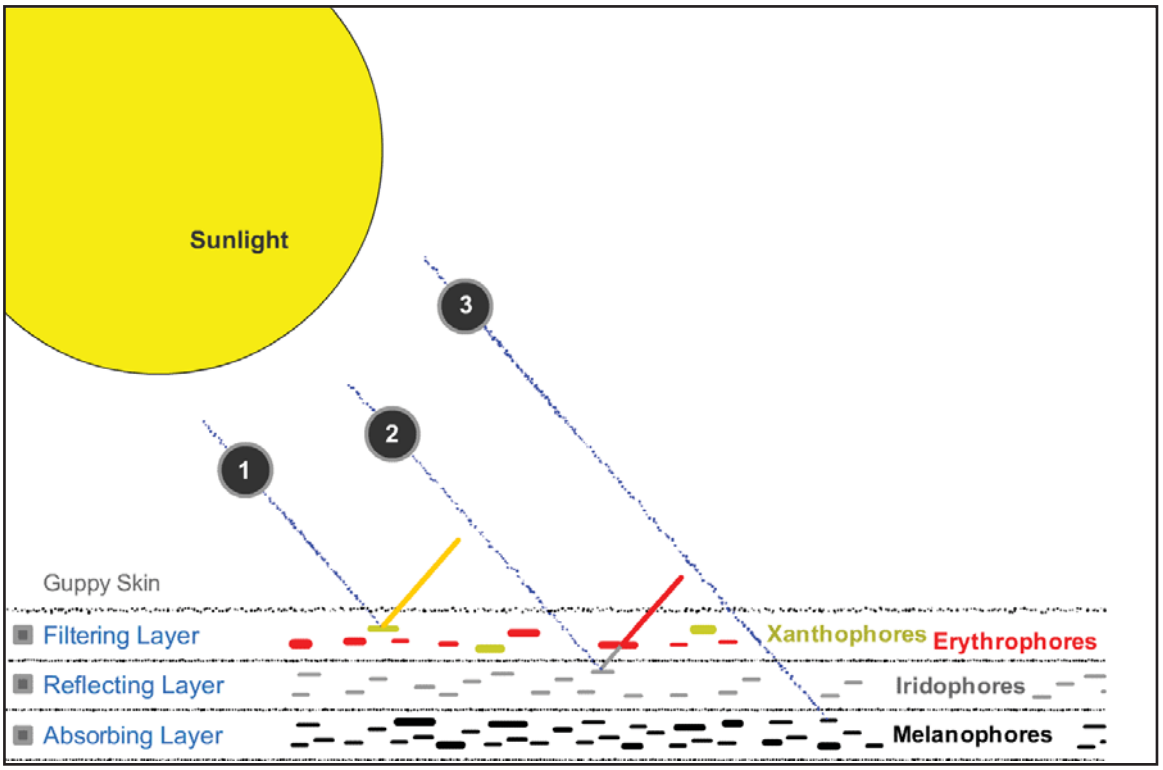


Fig. 3 Guppy Color System. See Bagnara and Hadley (1973) "Chromatophores and Color Change" for a detailed description of the color system used by fish, amphibians and reptiles.

that are bouncing around in the layers of the skin.

- The middle **Reflecting Layer** scatters or refracts light. It reflects light from the body like tinfoil or white metal.
- The top **Filtering Layer** is made up of pigment color cells that selectively absorb different parts of the light spectrum. For example, the yellow color cells absorb all but the yellow part of the light spectrum. The yellow part of the light spectrum is reflected.

In the diagram, three rays of sunlight have been labelled 1, 2, and 3. Each of these rays penetrates the skin and strikes a color cell.

1. The **first** ray immediately strikes a yellow color cell (xanthophore). All but the yellow part of the ray's light spectrum is absorbed. The yellow light is reflected. You would see yellow on the skin of the guppy.
2. The **second** ray strikes the reflecting platelet of an iridophore, a type of color cell that reflects and scatters light. The ray is reflected back up and passes through a red color cell. The red color cell acts like a filter, absorbing all but red light. You see metallic red on the guppy, such as coral red. If the ray had not struck a color cell on its way back up through the skin, the viewer would

see such metallic colors as Japan Blue, silver or Micariff metallic white. See Figure 4 below.

3. The **third** ray passes right through to the melanophores at the base of the skin, where it is absorbed and not reflected.

Examples of Reflected Colors

In the series of pictures below, you will see how the color light is subtly changed by the different color cells at different layers. The example is colors reflected off of iridophores and filtered by the pigment color cells.

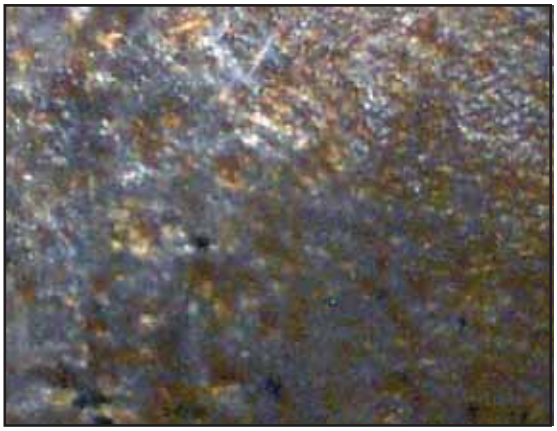


Fig. 4 Microscope view of a guppy with a lot of silver iridophores. Notice that the yellow color cells above the iridophores filter the light, producing a gold color. The light is shining directly down from above. The light reflecting off the iridophores, and back through the yellow color cells gives this guppy its burnished gold look.

Iridophores come in three common colors: blue, white and silver. (See the *Iridophores: Metallic and Platinum Colors* article in the Notes section.) This is not the color of the iridophore, since iridophores are colorless. Rather it is the color of light selectively reflected by the iridophore. (There are also color interference colors, but they will be ignored at this time.)Seen from a distance, the combination of the silver light reflecting iridophore and yellow pigment color cells (Fig. 4) looks like a gold metallic guppy (Fig 5).

Fig. 5 Gold Metallic Guppy. Philip Shaddock

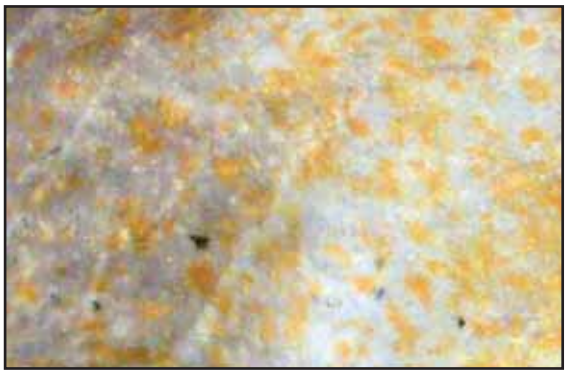


Fig. 6. Here is the skin in Fig. 4 again. Notice the dramatic difference. In this case, the light is not bouncing off the iridophores, but passing through them from below.

Fig. 7 The yellow color cells are probably sitting on top of white light-reflecting iridophores. Photo: Tomoko Young

This is a simplified view of the guppy color system. It assumes a normal or wild-type arrangement of color cells. Mutations cause the color cells at each of the layers to increase or decrease in density, size and number, or be absent altogether. A Moscow guppy has a huge number of black color cells and relatively few in the other layers.

Mutations like blond (U.S. gold) in effect remove the effect of a complete class of color cells (Fig. 8).

Fig. 8 This blond Half-Black white guppy is missing the black component of the Guppy Color System.

Color Mixing

To some extent you can think of the Guppy Color System as a color mixing system, not unlike the way colors are mixed in the computer monitor. This brings us to the art of guppy breeding, based on the science of the Guppy Color System.

The computer monitor is capable of displaying millions of colors. But it uses only three primary colors to do this, mixing them to get the other colors. The color wheel can be pictured like this (Fig. 9).

The three triangles at the center of the wheel, red, yellow and blue, represent the three basic color cells in the guppy, the red, yellow and blue iridophore colors. Black is spread evenly among the three colors, varying the darkness or saturation of the color.

Fig.9 The Guppy Color Wheel

Like the tiny beams of light coming from the computer monitor, the light bouncing off the tiny color cells of the guppy mixes to create millions of colors. For example, the guppy color green is a result of the mixing of yellow pigment color and the reflected blue light from iridophores. If you look at the color wheel, you will see that green (marked 1 on the diagram) is the combination of yellow and blue.

Similarly a Purple Moscow has a mixture of red and blue-light reflecting color cells (marked 2 on the wheel).

The third example is orange (marked 3 on the diagram), a mix of red and yellow.

Further Reading

See *Xanthophores / Erythrophores: Yellow and Red Color Cells* in Notes.
See *Melanophores: Black Color Cells* in Notes/
See *Iridophores: Metallic and Platinum Colors* in Notes.

2 Gene Symbols

Many of the entries in the Guppy Color Bank include formulas (genotypes) that show the genes that make up guppy color and patterns and where the genes are located. This section will help you understand how to interpret the formulas.

What are *abstract* and *physical* genes?

It is important to understand that when people talk about a "snakeskin gene," they are not describing a segment of DNA on a chromosome. The snakeskin gene is part of a **gene complex**, composed of closely linked genes.

Because they exist side-by-side on a section of DNA and are often inherited together, they behave like a single gene. There are guppy genes that do reference a specific segment of DNA, like the albino gene. But the vast majority of the color and pattern genes on the guppy are actually groups of genes, more or less tightly linked on a single chromosome and inherited in simple Mendelian terms.

The only way to identify a real, physical gene is through chemical analysis of an actual chromosome. The guppy **genome** (the sum total of genes on the guppy chromosomes) at the time of this writing has yet to be completely sequenced, and even when it is, further research will have to be done to determine the role of each gene. The existence of a physical gene or genes affecting the snakeskin pattern *may* be confirmed at some point in the future when the guppy genome has been sequenced. But until the *physical* DNA gene is found and its role in guppy color confirmed, genes like the snakeskin geen remain abstract entities.

There is a lot of discussion about genes on guppy forums and a few people have catalogued them in gene tables. But the evidence for these genes is highly circumstantial and the jury is still out on whether or not most of them actually exist as single genes.

Scientists have found and related DNA gene segments to colors and patterns in fish. These phyiscal genes have been found on the chromosomes of such fish as the zebrafish, but there is no *guarantee* they will be found to exist in the guppy.

What follows are the notation conventions we follow in this book and on the Guppy Designer site. If you do not understand terms like "autosomal," please read the section at the end of the book titled, *Common Genetic Terms*.

Autosomal Notation

Gene symbols look like this:

a/a

The letter "a" is the first letter of the name of the

mutation (albino in this case). It is shown as two letters divided by a slash because guppies have two sets of chromosomes and therefore two alleles. The slash indicates that the alleles are on different chromosomes.

The wildtype form of the gene is indicated by capital letters:

A/A

The capitalized version of the gene symbol indicates it is dominant.

This shows how a guppy that has one wildtype gene and one mutant gene is indicated:

A/a

In the case of an albino cross, the grey allele is said to be dominant and the albino allele is said to be recessive, and the result of the cross would be all grey fry in the first generation of the cross. So the **phenotype** of the hybrid guppy would be grey, and the **genotype** would be ***A/a***.

Sex-Linked Notation

A gene on an X and Y chromosomes is represented as (the platinum mutation in this case):

$X^{P}Y$

This indicates the guppy has the Platinum gene on the X-chromosome, and the wild type allele on the Y-chromosome. The gene symbol is capitalized to indicate it is dominant over its wild-type allele.

Because genes can cross over to the opposite chromosome during sexual reproduction, the genotype shows the most common location of the mutant allele.

When there is more than one letter in the symbol name it is shown like this:

$XY^{(Ssb)}$

This guppy has the Snakeskin body gene on the Y-chromosome and it is dominant over its wild-type allele.

In the case of a dominant allele, you will often see a "-" dash associated with it, as in:

M/-

This indicates that it does not matter if the allele on the other chromosome is the wild-type or not. That's because the wild-type allele is recessive, so the dominant phenotype will be expressed either when the dominant allele is heterozygous or homozygous.

There are some cases where the dominant allele requires the presence of the recessive allele for a trait to show. For example, the dominant autosomal Asian Blau mutation requires the presence of the recessive allele for the blue metallic trait to appear ***(Nb/nb)***. When the Asian Blau allele is homozygous ***(Nb/Nb)***, the guppy has a white phenotype instead of a blue phenotype.

3 Color Bank Strains

There is no good way to absolutely categorize guppies into strains, where a **strain** is defined as a guppy lineage that produces sons and daughters that are 80% similar. An example is a Panda Moscow, a guppy with both Moscow with the Pink mutations (Fig.1).

Fig.1 Panda Moscow. Photo by Finn Bindeballe

The Panda belongs to both Moscow and Pink categories.

Then there is the "Glass Belly Panda," which combines the Glass Belly, Pink and Moscow mutations (Fig.2). This is a guppy that belongs to three different categories

There are European, American and Asian show guppy standards that categorize guppies according to their appearance: long or short dorsal, triangle or delta-shaped caudal fins, the presence or absence of red eyes, and so on. But the categories are arbitrary and based on examination of guppies with the naked eye under show lighting. Such observations are subject to error.

Fig. 2 Glass Belly Panda. Photo: Philip Shaddock

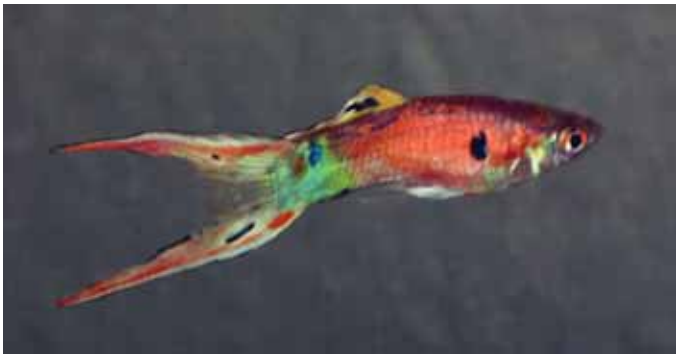
Classification systems like those used at guppy shows have to do with **phenotype**, *what you see*. The designer is interested in **genotype**, the actual genes that are determining the appearance of the guppy.

To avoid these classification issues, we have adopted a tag-based system on the Guppy Designer website, where a guppy is simply tagged with all the possible categories it can belong to and guppies can be searched online according to these categories. In this paper version of the Color Bank the index at the back of the book can be used for the same purpose .

Here is a table of the current categories.

Body Color	Body Patterns	Fin Color and Pattern	Fin Shape
Black	Bandit Markings	Black Tail	Doublesword
Blue	Bar Gene	Blue Tail	Elongated (Hi-Fin) Dorsal
Gold	Emerald Green Iridescent	Mosaic Tail	Fantail
Green	Full Red	Red Tail	Lower Sword
Orange	Galaxy	Snakeskin Tail	Pintail
Purple	Grass	White Tail	Ribbon (Giessen)
Red	Half-Black (Ni)	Yellow Tail	Roundtail
Silver	NII		Spadetail / Coffertail
White	Japan Blue		Speartail
Yellow	Medusa		Swallow
Wild	Moscow		Swordtail
	Panda		Upper Sword
	Pink White		
	Red Spots		
	Snakeskin		
	Snakeskin Body		
	Snakeskin Tail		
	Variegated		
	Vienna Emerald Green		
	Wild Type		
Metal Cell Mutations	**Pigment Cell Mutations**	**Country or Club**	**Other**
Blue Diamond	Albino (RREA)	Asian	Female
Coral Red	Asian Blau	European	Double Mutant
El Dorado	Blond (U.S. Gold)	IFGA	Triple Mutant
Emerald Green Ird.	Glass Belly	IKGH	
Japan Blue	Golden (U.S. Bronze)	Japan	
Lazuli	Magenta		
Leucophore	Pink / Pingu		
Metal	WREA (Lutino)		
Micariff			
Platinum			
Santa Maria			
Stoerzbach			

Coral Red Doublesword



Coral Red Doublesword. Photo by Finn Bindeballe

Description

This strain has a coral red body combined with the Emerald Green Iridescent (EGI) pattern. The emerald green iridescence spreads into the front of the body. Notice the black stripe across the top of the front of the body and in the top part of the peduncle. These are also characteristic of the EGI gene. They have a blue or greenish blue metallic color on the lower part of the peduncle, sometimes stretching into the belly area, probably due to the EGI gene complex.

The black spot in the front of the body is characteristic of the EGI gene.

Genetics

See the *Coral Red* entry in the Notes section for Coral Red genetics and the *Emerald Green Iridescent* entry in the Notes section for a discussion of the genetics of these traits. See the *Swordtail Fin Shape* article in the Notes section for the genetics of the sword fin shape.

This guppy's genotype would be:

$X^{(Ds)}Y^{(Ds)(Co)(SmIr)}$

Where Ds = doublesword genes on both the X and Y chromosomes, Co = coral red, SmIr = Emerald Green Iridescent.

Robert Gall, a breeder of Lazulis and Coral Red, thinks that the two strains might have related genetics. See his Breeders Comment in the *Lazuli* strain entry.

Categories

Cat: European; Cat: IKGH; Cat: Red; Cat: Swordtail; Cat: Doublesword; Cat: EGI; Cat: Coral Red

Half-Tuxedo Snake Speartail

Half-Tuxedo Snake Speartail. Picture by Finn Bindeballe at a Danish guppy show.

Other Names
Saddleback Snake Speartail

Description
The guppy has a half-tuxedo (aka saddleback) pattern, meaning the top half of the peduncle, from the dorsal to the base of the caudal, is black while the bottom half is another pattern.

Genetics
See the *Saddleback / Half-Tuxedo* article in the Notes section.

See the *Half-Black (Ni or NII)* article in the Notes section.

See the *Snakeskin* article in the Notes section.

See the *Speartail* article in the Notes section.

Categories
Cat: European; Cat: IKGH; Cat: Red; Cat: Speartail; Cat: Half-Black; Cat: Snakeskin Body

Platinum Pintail

Platinum Pintail. Picture taken at a Danish guppy show by Finn Bindeballe.

Description
See the *Pintail Fin Shape* article in the Notes section of the Color Bank.

Genetics
The Pintail fin shape is considered to be X-linked.

The strain appears to have two types of platinum: gold and blue. However we cannot be certain because of the exigencies of lighting. See the *Platinum* entry in the Notes section at the end of the Color Bank.

Categories
Cat: European; Cat: IKGH; Cat: Double Mutant; Cat: Pintail; Cat: Platinum; Cat: Gold

Albino Yellow Full Platinum

Albino Full Yellow Platinum. Guppy and photo by Philip Shaddock.

Other Names

Commonly called a "Full Platinum"

Description

The Full Yellow Platinum has a shiny metallic sheen throughout the body, and a consistent yellow color. The yellow color comes from an overlying layer of yellow color cells. The platinum color underneath is white. For comparison with a strain without the yellow color cells see the *Full White Platinum* entry. The female of this strain also appears to have the platinum gene, as she shows yellow platinum color in her body:

Female Full Platinum. Guppy and photo Philip Shaddock

Genetics

This version of the strain also has the albino gene. It has the blond gene as well. Finally it has the half-black gene, which some consider necessary to the expression of the platinum phenotype. The half-black gene is X-linked. So its genotype is:

$X^{P\ (Ni)}\ Y^{P}$ a/a b/b

P = platinum, a = Albino, b = Blond, ni = Half-black

For a complete discussion of platinum genetics see the *Platinum* entry in the Notes section at the end of the Color Bank.

Breeders Comments

Philip Shaddock

Here is the F1 generation cross between a Full Platinum male and Mellor Half-Black Pastel.

Notice that it is a blond guppy. This was a surprise, as I did not know the Mellor HB Pastel guppy I bought at auction was harboring the blond gene. Nor did I know that the Full Platinum was harboring the blond gene! In the F2 generation the albino fry developed into the Mellor phenotype in terms of body and fins and the Full Platinum phenotype in terms of the color.

A notable consequence of the cross was a much more fragile guppy. They did not inherit the robustness and vitality of the Thai strain.

Categories

Cat: Metal; Cat: Platinum; Cat: Yellow; Cat: Albino; Cat: Blond; Cat: Half-Black

Blond Stoerzbach Doublesword

Doublesword blond Störzbach, a young adult male.
Guppy bred by Erwin van Wirdum, owner and photo Karen Koomans

Other Names
Blond Störzbach Doublesword

Description
This is an IKGH standard doublesword. (See the *IKGH General Information* entry.) It has the Stoerzbach metal trait. That is its light-reflecting iridophores give the body a metallic yellow-green sheen.

Genetics
It is difficult to tell, but the guppy at the top of this entry may in fact be a combination between an Emerald Green Iridescent gene and a Stoerzbach gene. (See the *Emerald Green Iridescent* entry and the *Stoerzbach Metal* entry in the Notes section of the Color Bank.)

Categories
Cat: Metal; Cat: Stoerzbach; Cat: Doublesword; Cat: Swordtail; Cat: Blond

Blue Diamond (Luster)

Junichi Ito supplied us with this photo of a Luster guppy.
It is likely to be the same as the Blue Diamond guppy.

Description
This mutation causes a proliferation of blue color on the guppy.

Genetics
The genetics of this strain is discussed under the *Blue Diamond (Luster)* heading in the Color Bank Notes section.

Categories
Cat: Metal; Cat: Blue Diamond

Full White Platinum

White Platinum. Guppy by Luke Roebuck.

Description

This spectacular "metal white" guppy has a black spot in the peduncle, and has a blue highlight in the fins. What makes it interesting is the highly reflective metallic texture of the guppy. Compare it to the *Albino Yellow Full Platinum* in the Color Bank.

This guppy is F1 of a cross between a Full Platinum and IFGA HB Pastel

Genetics

See the *Platinum* entry in the Notes section of the Color Bank.

The guppy is likely to have the half-black gene.

The fact that it is not showing any yellow color indicates it has some kind of mutation preventing the expression of yellow color cells.

Categories

Cat: Metal; Cat: Platinum; Cat: White; Cat: Silver; Cat: Blond; Cat: Half-Black

Red Tail Yellow Platinum Spadetail

Photo by Finn Bindeballe. Taken at a Danish guppy show.

Description

The Spadetail fin shape is relatively rare in Europe. It is an old shape, dating back to the 40s in the previous century. The shape of the caudal was named "coffertail" by the developer of the tail shape, W.G. Phillips, who was reminded of a mining shovel shape. Now it is more commonly known as a "spadetail." See the entry for *Spadetai*l in the Notes section at the end of the Guppy Color Bank.

The body appears to be under the influence of a platinum gene, while the fins are due to a red tail gene.

Genetics

The putative genetics of this guppy is:

$X^{(Rdt)(Spt)}Y^{P}$

Where Rdt = red tail fins, Spt = spadetail, P = platinum

Categories

Cat: European; Cat: IKGH; Cat: Red Tail; Cat: Spadetail; Cat: Platinum

Metal Head Red Tail Snakeskin Roundtail

Picture by Finn Bindeballe. From a Danish guppy show.

Description

This guppy combines a number of interesting traits.

It appears to have red spots in the peduncle area. See the article on *Red Spots* in the Notes section at the end of the Color Bank.

Genetics

The base strain is Blue Moscow. The Moscow was crossed with a snakeskin, possibly a red tail snakeskin or a red snakeskin.

The putative genetics of the strain are:

$X^{(Rdt)(Sst)(Ssb)}Y^{(Rndt)(Mw)}$

Where Rdt = Red tail, Sst = snakeskin fins, Ssb = snakeskin body, Rndt = Roundtail, Mw = Moscow

For further information about the combination of the snakeskin and Moscow genes, please see the *Metal Head Snakeskin* entry.

Categories

Cat: European; Cat: IKGH; Cat: Red Tail; Cat: Moscow; Cat: Roundtail; Cat: Snakeskin; Cat: Blue

Blond Red Fin Snakeskin Roundtail

Blond Red Fin Snakeskin Roundtail

Description

This guppy combines a number of traits.

Genetics

The guppy incorporates the blond gene, the snakeskin genes (body and fins) and possibly the red tail gene as well.

The putative genetics of this strain is:

$X^{(Rndt)(Rdt)}Y^{(Sst)(Ssb)}$ b/b

Where Rndt = Roundtail, Rdt = Red fins, Sst = Snakeskin fins, Ssb = Snakesin body

References

For more information about the snakeskin pattern see *Snakeskin General Information* in the Notes section of the Guppy Color Bank.

For more information about the blond mutation, see *Blond and Golden Mutations* in the Notes section at the end of the Guppy Color Bank.

Categories

Cat: European; Cat: IKGH; Cat: Red Tail; Cat: Snakeskin; Cat: Roundtail; Cat: Snakeskin; Cat: Blond

Upper Sword Japan Blue Snakeskin

Upper Sword Green Snakeskin. Photo taken at a Danish guppy show by Finn Bindeballe

Description
The snakeskin has an upper sword.

The background to the snakeskin pattern appears to be Japan Blue.

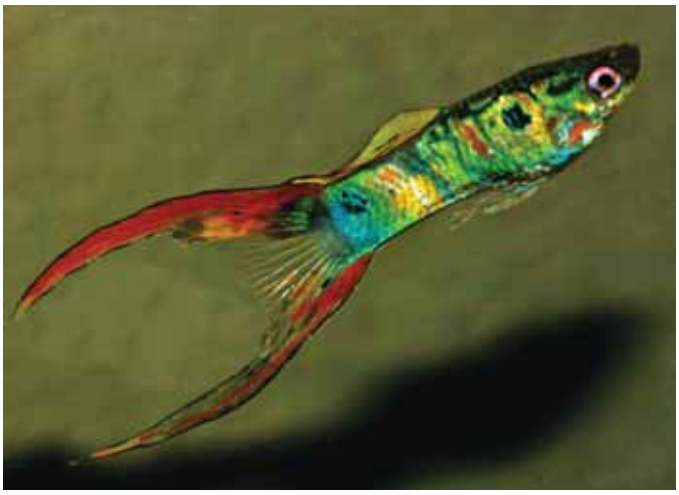
Genetics
This guppy has both the gene for the snakeskin body (Ssb) and fins (Sst). See the *Snakeskin General Information* article in the Notes.

For the sword tail genetics see the *Swordtail Fin Shape* article in the Notes section.

For the Japan Blue trait see the *Japan Blue* entry in the Color Bank.

Categories
Cat: Red Tail; Cat: European; Cat: IKGH; Cat: Upper Sword; Cat: Swordtail; Cat: Japan Blue; Cat: Snakeskin

Variegated Double Sword



Variegated Doublesword. Taken at a Danish guppy show by Finn Bindeballe

Description

This spectacularly colored and patterned variegated guppy probably is descended from a drab laboratory guppy once cultured by the German scientist M. Dzwillo. See the article "Emerald Green Iridescent" in the Notes section of the Guppy Color Bank.

Another guppy of this type. Finn Bindeballe picture.

This guppy has other mutations in its makeup, but its base genotype can be rendered as:

$X^{(Ds)(Rdt)}Y^{(SmIr)(Ds)}$

Where Ds = doublesword, Rdt = Red Tail fins, SmIr = Emerald Green Iridescent

Categories

Cat: European; Cat: IKGH; Cat: Doublesword; Cat: Swordtail; Cat: EGI; Cat: Red Tail; Cat: Variegated

Albino Full Red

Albino Full Red. Courtesy Carlos Beserra.

Description

This is the albino version of the *Full Red*. Please see that listing for information on the strain.

Categories

Cat: Red; Cat: Full Red; Cat. Albino

Orange Platinum

Orange Platinum. Photo Philip Shaddock

History
This strain was discovered in a pet store.

Description
The distinctly orange color should be compared to Coral Red to get some idea of the range of reds found in platinums.

Håkan Turesson's Coral Red

Genetics
Please see the entry for *Platinum* in the Notes section at the end of the Color Bank for platinum genetics.

The guppy may have the Emerald Green Iridescent gene as well. See the *Emerald Green Iridescent* entry in the Notes section of the Color Bank.

Categories
Cat: Metal; Cat: Platinum; Cat: Orange; Cat: EGI

Yellow Snake Spade

Yellow Snake Spade. Hans Peter Neuse

Description

Although Hans-Peter Neuse's Spadetail looks like it has Galaxy heritage, according to Hans Peter it does not. Hans Peter's strain is based on a line created by Diethelm Schröers, but developed much further. Hans Peter says: "Diethelm developed this strain with yellow snake females (Roundtail) and Blond Red males, also Roundtail. In my tanks some of these blond reds are swimming. They are very nice with a golden metallic body. The red in the fins is a little bit orangish but I like them. There are no Japanese crosses into this strain. The blond reds come from Germany (Peter Uhlig) the yellow females too (Ralf Loch). The shape of the caudal and the pattern is near perfection, of this quality I have only a few." Hans-Peter's Gold Red Snake Spadetail was a winner at the DGLZ Leistungsshau.

Genetics

See the *Snakeskin General Information* and *Spadetail Fin Shape* articles in the Notes section.

This strain has black areas of color on the front of its body typical of many snakeskin strains, especially the Galaxy, suggesting that even if it is not descended from an imported Galaxy, it may indeed have the Galaxy phenotype. See the *Bandit Markings* article in the Notes section.

Categories

Cat: European; Cat: IKGH; Cat: Snakeskin; Cat: Spadetail; Cat: Yellow; Cat: Bandit Markings; Cat: Galaxy

Shadow Dancer

Shadow Dancer. Picture by Luke Roebuck

Other Names
Grass Moscow

Description
This is one of the crosses that Japanese breeders have made with the Moscow. In this case the "Shadow Dancer" is a cross between a Japanese female grass guppy and a male blue Moscow. Luke Roebuck comments on the Japanese origin of the name of this Moscow variation: "Sometimes the bodies become so black when the males are in mating condition that, against a black background, the fish almost disappears (camouflages) against the background, except for the brightly colored and contrasting fins. What you see is brightly colored variegated fins dancing around the tank!" Luke comments on the genetics: "A cross between a Moscow male and any kind of leopard/grass female will eventually lead to a variation of what the Japanese call "Shadow Dancer" in their Full Metal Blue Glass Strains. Willi Kosa in Germany also has been developing Moscow Leopards which are a different form of "Shadow Dancer." They don't have Blue color in their fins. Since the name Shadow Dancer is not genetic-based and derived from the specific cross of the Moscows and Blue Glass, Japanese breeders don't usually extend this name to the other variations. However the genetic name Full Metal Glass or Leopard remains basically the same. Only the colors vary. This is strictly my opinion.

I have some pictures of the Shadow Dancers and Willi Kossa's website has pictures of the Full Metal Leopards which have yellow/white color base in the fins and very dark bodies. They are not related to the Blue Glass or Japanese Shadow Dancers, but have compatible and "analogous" breeding color genetics. Sometimes it is best to understand how some strain names are derived so as to be able to correlate the strain with

other possible compatible variations."

Genetics

See the *Moscow General Information* entry in the Notes section.

See the *Grass Guppies* entry in the Notes section.

The genotype for this strain is:

$X^{(Gra)}Y^{(Mw)}$

Where Gra = grass, Mw = Moscow

Categories

Cat: Moscow; Cat: Asian; Cat: Japan; Cat: Grass; Cat: Blue; Cat: Double Mutant

Half-Black Full Red

Picture courtesy Finn Bindeballe. Taken at a Danish guppy show.

Description

This European standard Half-Black Red is interesting for the red on the head.

Genetics

This must be a cross between a Full Red and a Half-Black strain, such as a Half-Black Red.

The half-black genetics are described in the Notes as the *Half-Black* (Nigrocaudatus Ni)

So the genotype of this guppy is likely to be:

$X^{(Rdt)}Y^{(Ni)}$

Where Rdt = red tail, Ni = half-black

Reference

See the *Full Red* entry.

Categories

Cat: European; Cat: IKGH; Cat: Red; Cat: Full Red; Cat: Half-Black; Cat: Red Tail

Upper Sword Black Snakeskin

Upper Sword Black Snakeskin. Photo taken at a Danish guppy show by Finn Bindeballe

Description

The snakeskin has an upper sword.

The background to the snakeskin pattern appears to be black. Compare this guppy to the Upper Sword Green Snakeskin.

Genetics

This guppy has both the gene for the snakeskin body (Ssb) and fins (Sst). See the *Snakeskin General Information* article in the Notes.

For the sword tail genetics see the *Swordtail Fin Shape* article in the Notes section.

Categories

Cat: European; Cat: IKGH; Cat: Snakeskin, Cat: Black; Cat: Upper Sword; Cat: Swordtail

Yellow Grass

Larry Hollingsworth's Yellow Grass

Description

This is one of the color varieties of the Grass guppy. It has a great deal of yellow color cells.

See the Notes article *Xanthophores / Erythrophores: Yellow and Red Color Cells* for a discussion of yellow color cells.

Categories

Cat: Grass; Cat: Yellow; Cat: Bandit Markings

Galaxy Yellow Grass

Hiwatari Galaxy Yellow Grass. Picture sent to Philip Shaddock by Eddie Lee

Description

Eddie Lee, a guppy broker in Taiwan, calls this strain the Hiwatari Galaxy Yellow Grass. There is a metallic blue patch in the front of the body, which usually is a marker for this strain.

Genetics

The Grass and Galaxy guppies make excellent and interesting crosses and are much loved in Asia. The Galaxy itself is a combination of the Platinum and Snakeskin alleles. See the Color Bank strain entry for *Galaxy*.

The blue area of color in the front of body of this Galaxy is typical. It is discussed in the *Bandit Markings* article in the Notes section.

See the Notes section article on *Platinum*.

The putative genotype for this guppy is:

$X^{(Gra)}Y^{P(Sst)(Ssb)}$

Where Gra = grass; P = platinum; Sst = snakeskin tail; Ssb = snakeskin body

Categories

Cat: Grass; Cat: Galaxy; Cat: Yellow; Category: Platinum; Cat: Snakeskin Body; Cat: Snakeskin Tail; Cat: Snakeskin; Cat: Triple Mutant; Cat: Bandit Markings

Red Grass

Blood Red Grass. Picture courtesy Eddie Lee

Description

Eddie Lee describes this guppy as "Blood Red Grass."

Genetics

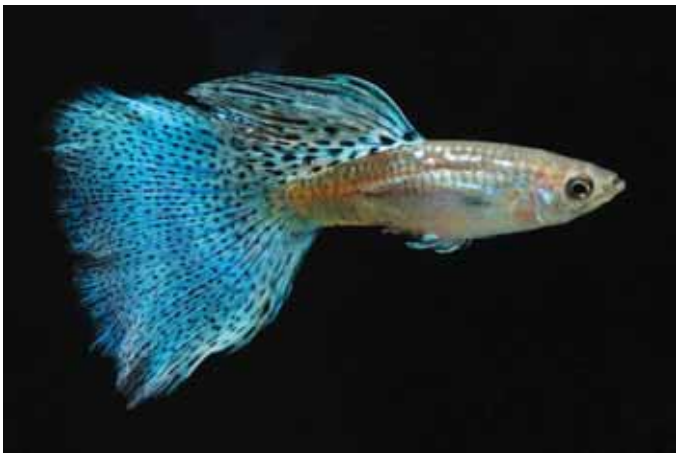
The guppy appears to be a cross between a Full Red and Grass guppy.

For information on red color cells, please see *Xanthophores / Erythrophores: Yellow and Red Color Cells* in the Notes section. Also see the *Full Red* entry.

Categories

Cat: Grass; Cat: Red; Cat: Full Red

Blue Grass



Beautiful Blue Grass by Andrew Lim.

Description

The Blue Grass is a variant of the Grass strain that incorporates the Asian Blau mutation, called "r2" in Europe. As in the picture above, the guppy is a brilliant, metallic blue.

Genetics

Here's how to breed the Blue Grass. The Blue Grass has the Asian Blau mutation, also called Asian Blau. When you acquire the Blue Grass version of the strain from a breeder, you actually acquire both the red and blue variations. That's because the Blue Grass is a hybrid with heterozygous blue and red alleles. The Blue Grass is created out of the Red Grass by crossing to a guppy with the Asian Blau mutation, variously called Asian Blau, r2 in Europe or Brao in Japan. ("Brao" is a variation in the spelling of "Blau.")

The Asian Blau allele is autosomal dominant. When the guppy is heterozygous for the Asian Blau allele, the blue iridescent color is produced. When it is homozygous for the Asian Blau allele, a dull, colorless phenotype is produced.

Since the Asian Blau mutation directly affects the body and not the fins, it is possible to have a Asian Blau fish with red fins. That is, the fins are given color by their own color genes. However, there is some influence of the body color genes on the color of the fins. Asian Blau mutants with red fins tend to have darker, more dull reds than grey, gold or albino guppies.

	Body Color	Color of Caudal Fin
RR	Grey	Red
Rr	Grey	Neon Blue
rr	Blau	Dull Dark blue

The homozygous Asian Blau mutants tend to be smaller and somewhat more fragile than their siblings. Knowing the genetics of the Blue Grass is necessary to maintaining or improving them. Left on their own to breed indiscriminately, they tend to segregate out to Red, Yellow, or Multi Grass versions.

The putative genotype for this guppy is:

$X^{(Gla)}Y$ Nb/nb

Where Gra = glass, Nb = Asian Blau

The Asian Blau allele is autosomal dominant (See *Autosomal Dominant* in the Common Genetic Terms section of the Genetics Appendixes.)

Reference

For a detailed explanation of the Asian Blau mutation and its application, see the *Asian Blau Mutation* in the Notes section.

Categories

Cat: Grass; Cat: Asian Blau; Cat: Blue; Cat: Double Mutant

IFGA Blue

IFGA Blue. This fish one first place at an IFGA show. Photo: Philip Shaddock

Description
The red spot in the peduncle area is typical of this strain.

Genetics
Since blue color comes from blue reflecting iridophores, and there are many possible types and configurations of iridophores (blue, green, yellow, white, silver) with varying degrees of density and thickness, there is great variance in the quality of the blue.

See the Notes section on *Red Spots*.

Categories
Cat: IFGA; Cat: Blue; Cat: Red Spots

Pink White Moscow

Pink White Moscow. Guppy and Photo by Philip Shaddock. 3.5 Months Old

Description

The Pink White Moscow shows its Moscow heritage in the blue green metallic color of its front of the body, and the black or metallic streaking in its caudal. The yellow iridescence in the front of the body is also characteristic of its descent from the Hawaiian Blue Moscow. Females have the characteristic Pink White trait, a white area at the base of the peduncle and caudal fin.

True to its descent from a Hawaiian Blue Moscow, this guppy has a red spot. See the *Red Spots* article in the Notes section.

Female Pink White Moscow.

Genetics

The Pink White Moscows in the photos above are F1 of a cross between a Hawaiian Blue Moscow male and a Green Platinum Pink White female. All the males in the drop looked almost identical, as well as all the females.

It is obvious from the F1 phenotype that the Green Platinum Pink White females brought the Pink White trait to the cross, showing as white fins and a white area in the male offspring and the white area to the base of the peduncle and caudal fin in the female offspring.

All the other traits are from the Hawaiian Blue Moscow: the metallic blue/green and yellow front of the body, the red spot in the peduncle and the black or metallic streaking in the fins. There is also a "chameleon" black area in the lower part of the caudal fin (from motile black pigment) that shows up under certain conditions. It is not known which parent contributed to this trait.

This cross demonstrates once again the dominance of the Y-linked genes of the Hawaiian Blue Moscows.

This cross also shows that the Pink White trait is dominant, since the inbred Hawaiian Blue line definitely does not have the pink white trait. Whether the Pink White trait is autosomal or X-linked remains to be confirmed, although some say it is X-linked. In any case, the F1 cross definitively establishes that the Pink White mutation is not the same as the Pink mutation, which is autosomal recessive and therefore would not show up in the first generation of a cross.

So the tentative genotype of the F1 generation of the cross is:

$X^{(Pw)}Y^{(Mw)}$

Where Pw = Pink White; Mw = Moscow

References

See the *Pink White General Information* article in the Notes section for more information about Pink White.

Categories

Cat: Moscow; Cat: Pink White; Cat: Green; Cat: Red Spots

Black Cobra

Black Cobra. Courtesy Buncha Silskulsuk.

Other Names
Black Snakeskin

Description
What distinguishes this version of the snakeskin is the jet black background to the snakeskin pattern, indicating the presence of a lot of melanophores (black color cells). Notice that the female has black fins.

Genetics
The black snakeskin appears to have either an X-linked or autosomal gene making the background pattern black.

See the *Snakeskin General Information* entry in the Notes section for the snakeskin family.

Categories
Cat: Snakeskin, Cat: Black, Cat: Half-Black, Cat: Asian

Taiwan Wild Guppy

Wild guppy. Photo by Eddie Lee

Description
This guppy was collected in a ditch in Taiwan.

Genetics
See the Notes section article *Red Spots* for the significance of the wild pattern.

Categories
Cat: Red Spots; Cat: Wild

Pingu or Pink

Picture and guppy by Luke Roebuck. According to Luke, David Liebman said his strain was closest to the original Pingus. You can see the resemblance between this strain and the picture in the ad below.

Other Common Names

The name "Pingu" is a contraction of "**Pin**k **Gu**ppy," given by the original developer of the mutation, David Liebman. All other names given to this guppy confuse its heritage. The so-called "European Pink" is probably the same mutation, with some different associated linked alleles (genes on the same chromosome). In Europe, the Pingu is considered to be a Pink that has a half-black allele in addition to the Pink mutation. This guppy is given the name "American Pink White." However, the exact nature of the European version of the strain is unclear. Until it has been definitely proven that Pinks and Pingus are different mutations, we have chosen to use the terms interchangeably.

History

The original mutation that gives this strain its name was developed by the American biologist, David Liebman. Here is an ad he placed in "Tropical Fish Hobbyist," December, 1979. The picture provides a good idea of what the original Pingu strain looked like. (See the ad on the next page.) Notice the similarity to the guppy at the top of this entry.

A clue to the origins of the Pingu is where it developed on the guppy's body. In his article, David Liebman shows in a picture of the original mutation (see the image beside the ad on the next page). Notice the pink spot in the upper part of the peduncle.

Original Ad advertising the Pingu

Pink spot on peduncle of early Pingu.

The original Pingu appears to be a half-black guppy, and the Pingu pattern appears to have begun with matching pink spots on both sides of the peduncle. Liebman was to selectively breed the pattern until it covered the peduncle area (see picture below right):

Description

The mutation appears to affect the black color cells, selectively turning them pink. Given that breeders report that crosses with other strains produces guppies with more metallic color, the evidence seems to point to a change during development in fate of black color cells to iridophores.

It is quite possible that the mutation only affects one or two types of melanophores (there are at least eight different types). This might explain why half-black Pingus look different then non-half-black Pingus. This explains the strange coloring of the Panda Moscow (see picture next page), a Moscow with the Pink mutation. The front of the body has a type of ectopic melanophore that is affected by the Pink mutation, while the rest of the body is under the control of the Moscow melanization gene.

Variations

It is said that the American pink guppy, the Pingu, has a black spot near its peduncle, and this distinguishes

it from European pinks. However this may just be an example of linkage, where a gene causing the aggregation of a type of melanophore into black spots is located on the same chromosome as the allele for the Pink mutation. Similarly there appears to be a Snakeskin allele that has found its way onto the same chromosome as the Pink mutation for European Pinks.

See the *Pink White General Information* entry in the Notes on the differences between Pinks and Pink Whites.

Fin Genetics

Crosses between pink guppies and other strains generally produce guppies with short fins. There has been a lot of speculation about this effect. The French breeder and guppy book author Ronan Boutot suggests that it may have something to do with the fact fin color cells and body color cells originate in different areas of the neural crest. There are cases where mutations affect the body differently from the fins, such as the Asian Blau mutation (called r2 in Europe). Recently there has been some reports that Panda Moscows, which have a long dorsal fin but a short caudal, have developed longer caudals. It may be the case that there is a gene that suppressed the length of caudal very close to the pink allele. In other words the short caudal may be due to linkage. The Pink White mutation does not affect the length of the caudal or dorsal in crosses.

Reference

The idea that the black color cells are selective in their response to mutations is discussed in detail in the Notes section under the Blond and Golden Mutation entry.

Categories

Cat: Pingu

Stoerzbach Moscow

Young Stoerzbach Moscow. Guppy and photo Philip Shaddock.

History

This strain is the result of a cross between a Hawaiian Blue Moscow (male) and a Stoerzbach Metal White (female). The guppis shown above are F3.

Description

The strain has two types, a yellow version and a yellow green version. Both versions become green metallic when they mature. The lower guppy in this photo shows the green phenotype.

The yellow color seen in this strain may be from the original Hawaiian Blue Moscow strain. See the *Hawaiian Blue Moscow* entry in the Color Bank for this.

There is a black spot at the juncture of the peduncle and the caudal.

Genetics

See the *Stoerzbach Metal* entry for the genetics of the metal gene. See the *Hawaiian Blue Moscow* entry in the Color Bank and the *Moscow General Information* entry in the Notes for the genetics of the Moscow.

What's interesting about this cross is that the Blue Moscow phenotype is almost entirely lost, including the colored Moscow head. This makes it possible that the Stoerzbach allele (if indeed it is Stoerzbach) is dominant over the body color allele on the Moscow.

The genotype of this strain is:

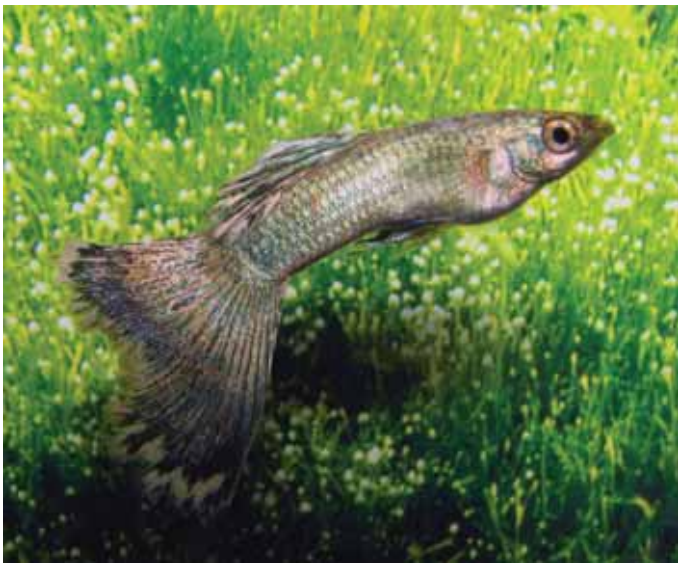
$XY^{(Mw)}$ s/s

Where Mw = Moscow; s = Stoerzbach metal

Categories

Cat: Stoerzbach; Cat: Moscow; Cat: Metal

Silverado



Silverado. Photo and Guppy by Philip Shaddock

Other Names
Platinum Flamenco Dancer, Platinum Magenta Moscow

History
An Asian Flamenco Dancer was imported. The female was bred to an Hawaiian Blue Moscow. It is probable the female was X-linked for the platinum allele. In about 1 in 50 fry, a highly platinum male was born. They were selected and inbred to produce the Silverado phenotype. This strain is similar to the Blue Silverado, only it has a different type of iridophore, silver iridophores.

Description
The guppy in the picture was a young male (six months old). It's fins appear ragged and shredded easily. It is possibly due to the fact the strain originated out of the Asian Flamenco Dancer that had the ribbon allele.

Genetics
See the *Magenta* entry in the Notes section at the end of the Color Bank for extended comments on Magenta genetics.

The Moscow x Magenta cross seems to produce guppies with short and somewhat malformed fins. However this may have been due to the presence of a Ribbon gene in the original founding Flamenco Dancers.

An interesting developmental characteristic of this strain is that it first develops is yellow metallic,

then later loses the yellow color and becomes silver (peppered with black). The yellow color is due to yellow pigment color cells (xanthophores). It is possible that the gene underlying the yellow metallic color is inherited from the Blue Hawaiian. See that entry. Somehow the yellow color cells atrophy.

It's genotype is as follows:

$X^{P}Y^{(Mw)}$ M/-

Where P = platinum, Mw = Moscow, M = Magenta

The forward slash and dash (/-) means the allele is dominant.

Categories

Cat: Magenta; Cat: Moscow; Cat: Platinum; Cat: Silver

Blue Silverado

Blue Silverado. Photo and Guppy by Philip Shaddock

History

An Asian Flamenco Dancer was imported. The female was bred to an Hawaiian Blue Moscow. It is probable the female was X-linked for the platinum allele. In about 1 in 50 fry, a highly platinum male was born. They were selected and inbred to produce the Blue Silverado phenotype. This strain is similar to the regular Silverado, only it has blue iridophores (metal color cells) instead of silver iridophores.

Description

This was a young male (six months old). It's fins did not grow much longer. The cross is relatively short finned.

Genetics

See the *Magenta* entry in the Notes section at the end of the Color Bank for extended comments on Magenta genetics.

This particular strain probably gets its extra blue color from the Blue Hawaiian founding father. See the *Moscow General Information* article in the Notes.

It's genotype: XPY(Mw) M/-

Where P = platinum, Mw = Moscow, M = Magenta. The forward slash and dash (/-) means the allele is dominant.

Categories

Cat: Magenta; Cat: Moscow; Cat: Platinum; Cat: Silver; Cat: Blue

Albino Full Platinum Magenta

Guppy and Photo: Philip Shaddock. The guppy is only 2 1/2 months old.

Other Names
Pink Lemonade

History
This strain is descended from one male Moscow strain (Blue Hawaiian), an Asian Magenta and a Thai Full Platinum.

1. Hawaiian Blue Moscow (male) x Asian Flamenco Dancer (female) = Silverado
2. Silverado (male) X Full Platinum (female)

The male is F1 of the latter cross.

Genetics
See the *Magenta* entry in the Notes section at the end of the Color Bank.

See the *Albino Yellow Full Platinum* entry in the Color Bank.

Categories
Cat: Magenta; Cat: Moscow; Cat: Platinum; Cat: Silver; Cat: Albino

Onyx Black Moscow

Two tone Onyx Black Moscow. Guppy and photo by Philip Shaddock

History

This phenotype came out of a cross between a Hawaiian Blue male and Alderson HB Green female. Shown in the picture is an F2 generation male. The first generation males all looked similar to this:

F1 Onyx Male

Description

The Onyx Half Black Moscow has a very dark body that does not fade. The black on the body tends to be a duller, bluer black than regular Moscow Blues. The cross produced both dark fin males and light fin males. All the females have dark fins. The picture illustrating this entry shows a light fin Onyx. At this point in its development, the fins are more yellow and black than green or blue. These are colors that come from both sides of the cross.

Body Genetics

The Y-linked Moscow traits are carried by the male, as it is descended from a Moscow male. See the *Moscow General Information* article in the Notes for an extensive discussion of Moscow genetics.

The deep black body of this line is associated with the Half-Black gene inherited from the original female mother (Alderson Half-Black Green). The deep blackness of the females suggests that the HB Green line had the NII variation of the half-black allele. See the half-black (*Nigrocaudatus or NI / NII*) entry in the Notes section.

The half-black gene seems to help make the guppy more black than a non-half-black Moscow. However, the blackness may not be entirely due to the half-black gene, as an autosomal gene making the guppy black may have a role to play. (See the *Midnight Black Moscow* in the Color Bank and the *Moscow General Information* article in the Notes on the black component of Moscow color.)

In the F2 generation of the cross, there were basically three body color phenotypes:

1. Regular Hawaiian Blue Phenotype

The regular (1) phenotype is similar the original *Hawaiian Blue* line. (See the entry and its picture.) They grew up to look similar to Hawaiian Blues.

The gold (2) phenotype has a metallic gold sheen that is prominent in the young males, but tended to be lost as the guppy grew older. See the *Silverado* entry in the Color Bank for a discussion of this trait.

2. Gold Hawaiian Blue Phenotype

3. Half-Black (Onyx) Phenotype

Apparently the Onyx Black strain has inherited the same gene from the Hawaiian Blue as the Silverado. The half-black version (3) grew into the Onyx phenotype illustrated at the top of this entry. The regular and gold versions of the Hawaiian phenotype are essentially the same. Females came in two basic phenotypes: dark black and light grey. A count of the phenotypes in two F2 drops is as follows:

#37	#40	#48	**Totals:** (Putting Hawaiians together)
HB (Onyx) Male 3	HB (Onyx) Male 4	HB (Onyx) Males 8	Black Males: 15
Hawaiian Male 5	Hawaiian Male 4	Gold Hawaiian Male 27	Hawaiian Males: 37
Gold Hawaiian Male 1	Gold Hawaiian Male 0	Black female 7	Black Females: 10
Black Females 3	Black Females 0	Grey Female 32	Grey Females: 61
Grey Females 13	Grey Females 16		

The ratios between Onyx and Hawaiian phenotypes is 2.5 to 1, not far from the 3:1 ratio you would expect from a recessive gene.

The female ratio of dark to light is about 6:1. However, it was difficult to sort the females into the two categories. Many were dark grey. It is possible there was actually three categories: light, medium and dark.

In discussions with Dr. José René Meléndez Berríos, who also breeds this strain, and Buncha Silskulsuk, who has experience with the Midnight Black Moscow, it seems likely that the differences in the phenotypes (Hawaiian or Onyx) is probably due to both an autosomal gene (Midnight Black) making the guppy black, as well as the Half-Black NII allele (Onyx Black). If you look at the F1 male above, you will see that it is hard to determine if the HB gene, which the male inherited from his mother, is present or not. Similarly, in the F2 male at the top of this entry, it is difficult to see the Half-Black pattern. Further crosses between Moscows and other half-black strains will help determine if the Alderson Half-Black Green line that was used for this cross has a form or half-black or another gene that creates this type of Black Moscow.

The question outstanding is whether the NII allele is different from the NI allele in its influence over the Moscow.

Original Hawaiian Blue strain male.

The interesting observation to be made about the F1 male and subsequent F2 Onyx Black males is that a dark, dull black color normally associated with the peduncle area of the HB strains, is over the entire body. This is confirmed by the fact that it is not a black that fades, as in the case of the black color of Moscows without the HB allele. Either there is an additional gene involved (an Onyx gene) or the NII HB gene exerts its influence over the entire body when it is incorporated into a Moscow strain. Buncha believes that it is both. He believes the half-black allele and an autosomal allele account for the dense black non-motile black color.

Dr. Berríos's observations support Buncha's theory. He notes that the color differences seen in the cross are are due to whether the HB gene is heterozygous or homozygous. So:

1. Heterozygous HB gene = F1 type male and F2 heterozygous phenotype males.
2. Homozygous HB gene = Onyx Black phenotype
3. No HB gene = Blue Moscow

Since the HB gene is normally dominant to other color genes, Dr. Berríos suggests there must be another allele or gene involved. This would make the Onyx Black allele co-dominant with this other allele. This provides a theoretical explanation for the F1 male, which appears to be a mix between the two phenotypes.

The question is whether or not the Onyx black (non-fading) color and the Moscow chameleon black color are alleles or separate genes.

The genetics of the strain is provisionally:

$X^{(NII)}Y^{(Mw)}$

Where NII = the NII variation of the half-black, mw = Moscow. The forward slash and dash (/-) indicate the allele is dominant.

What is not clear at this point is the relationship between the so-called Onyx gene and the Moscow black gene. Are they alleles or different genes?

See the *Midnight Black Moscow* entry for a discussion of the genetics of a similar Black Moscow imported from Thailand.

Fin Genetics

In the F1 picture above, notice that the fins are almost white. They darkened up and became bluer as the guppy grew older. In the F2 male at the top of this entry, the male appears to have yellow fins with dark streaking.

It is probably the case that the fins appear to be lighter because they are contrasted against a very dark body. However, with that said, it is the case that the fins are under the influence of separate color genes. See the *Leopard Moscow* entry for a Moscow with snakeskin fins.

Dr. Berríos has suggested that the deep yellow you see in the guppy at the top of this entry may be due to a yellow color cell gene coming from both sides of the cross, producing a double dose of yellow, i.e. $X^{(yt)}$ $X^{(yt)}$. You can see yellow in the caudal of the Blue Hawaiian and the HB Green has a lot of yellow color by default. However, it is still curious as to why the females have dark colored fins, not yellow, and why iridophores do not appear to be present, which would make the fins green and blue, not yellow.

Size and Fertility

The Onyx Black phenotype is smaller, less hardy and less fertile than its Moscow Blue siblings. This is a well-known phenomenon of black fish. Curiously, the Black Moscow with the Midnight gene is fertile and normal size. This may provide a clue to the biology of the mutation since loss of fertility is associated with an increase in melanin. If one form of the Black Moscow is fertile and the other is not, then it can be assumed that one form of the mutation affects the production of melanin and the other does not.

Reference

See the *Melanophores: Black Color Cells* in the Notes section.

Categories

Cat: Moscow; Cat: Black; Cat: Yellow Tail; Cat: Half-Black; Cat: NII

Albino Red Moscow

Albino Red Moscow. Guppy and photo: Oscar Inostroza

Other Names
Red Albino Moscow

Description
This strain has an intense red coloration with a solid red caudal and dorsal fin. The front of the body, head sides and belly shows clearly the Moscow metallic trait which in combination with the red pigmentation produces that pinkish metal effect. The head top is also red. There is some blue spotting in the caudal.

Another photo of the Albino Red Moscow

Dark Purple Moscow

History
Oscar Inostroza, a breeder of red guppies in Canada, was experimenting with crosses with his red albinos, intent on discovering their genetics. One of the crosses he attempted was to a Moscow imported from Taiwan, billed as a Purple Moscow. In fact the strain was probably a Midnight Black Moscow, one with the Midnight allele.

Oscar's goal was to uncover the traits passed down by Albino Red females, so he crossed a Black Moscow male with a Red Albino female. He has written about his experiment in his *Dark Purple Moscow Male XRed Albino Female* article on the Guppy Designer site. Oscar was also testing his PGT program, Pictorial Genealogical Tree, which allows him to keep both written and visual records of his crosses.

His F1 drop from the cross looked like this:

F1 Male

F1 Female

A couple of things noticeable about Oscar's F1 hybrid is that the Moscow body front and the dark spots in the caudal are dominant over the red color. Oscar assumed at the time that the dark spots in the caudal came from the albino female parent. However my own crosses with Moscows weighs the evidence in favor of the male parent (Black Moscow). The dark dots and streaks in the caudal are typical in many Moscow crosses. Also the X-linked Black Moscow fin color (black) seen in the F1 females appears to be dominant over the X-linked red color of the mother.

In fact, compare the F1 to the Metal Head Snakeskin and you will see that the allele or alleles coloring the front of the body of the Moscow appear to be dominant over other alleles, such as snakeskin.

Metal Head Snakeskin. Luke Roebuck

Notice that the Metal Head Snakeskin fins have the snake pattern. The snakeskin body markings (Ssb) and snakeskin fin markings (Sst) are due to separate alleles. The Ssb allele is dominant over (or is co-dominant with) the Moscow fin pattern allele.

In the F2 generation of the cross (the second generation), Oscar got both grey and albino fry. The albino came in two basic variations (next page):

F2 "Red Male"

F2 Green / Blue Male

A third type of male seemed to be a combination of the previous two. It was a light metallic pink.

F2 "Fluorescent Pink" Male

Notice that the spots in the caudal still appear in the red variation, and may be obscured by the metallic traits of the non-red variations. Because this is an albino, the spots are not due to black color cells (melanophores). (Albinos do not express black color.) They are due to a metallic allele, since metal color cells (iridophores) reflect blue light. This is further evidence of the Moscow origin of the spots, as it is the Moscow metal trait in the front of the body and the fins that is commonly dominant in crosses. In fact when you see the F3 generation of the cross, you will see that this Moscow allele is carried through all the generations and must be the Y-linked Moscow metallic trait.

The spots bothered Oscar, enough to make him rule out the red variation as the parent of the next generation. Oscar was not deliberately trying to create a Red Moscow.

Oscar reports that the red albino female phenotype re-appeared in this generation, segregating out. They came in two basic types. One had whitish metallic fins and the other had whitish metallic with a hint of red color.

F2 "Albino Red" Type Female

F2 "Whitish Metal" Female

He chose this second type (no red!) as his breeder female for the next generation. So Oscar chose both male and female breeders that had no red (female) or little red (pinkish male).

Despite his "negative" selection method, Oscar got Red Moscows in his third generation (F3).

Oscar reports that third generation produced about 90% Albino Red Moscow phenotype like this:

F3 Albino Red Moscow

F3 Albino Red Moscow with blue spotting

In the picture on the right you can see the blue spotting on the caudal.

If you look closely, you can also see the bluish metallic shine in the fore-body and caudal that are due to the Moscow blue metallic trait.

Fortunately for all breeders of Moscows and Reds, Oscar kept excellent visual and written records of his cross, and further documented the cross in his article published on the Guppy Designer site. It would be interesting to reproduce his experiment, but choosing the parents with the most red for the F3 generation, rather than the parents with the least red.

Oscar reports that about 10% of the drop (10 guppies) showed a lot less red color, including this individual:

F3 Male Very Light Pink

Analysis

Sometimes crosses, even those documented as well as Oscar has done it, can raise more questions than originally put forward. The question is whether he would have got 90% Red Moscows if he had chosen parents with more red color. Is there a "full body" gene (fbg) that converts a black / blue Moscow into a Red Moscow? The fact that Oscar arrived at a Red Moscow in only three generations suggests that this is a possibility.

There has long been a debate about red guppies and their solid red color.

One view is that there is a single full body gene (fbg) that colors all parts of the body red. Another says that there are about six red genes, coloring different parts of the body. The fact that Oscar was able to get 90%

full red albinos in just three generations suggests there are fewer genes involved in full red color. Oscar has pointed out on the forum, discussing this issue, you would expect the red color to be uneven if full red is a patchwork of red genes. However perhaps the truth does lie somewhere in the middle. Maybe there is a fbg gene that causes a proliferation of red color cells, and zone genes that hinder or help the spread of red color cells.

What Oscar's experiment does provide evidence for is that color and body zone coverage might be due to separate genes. The Moscow lost its blue / black head and became a red head. The Moscow (and other guppies by extension) must to a large extent be a blank canvas as far as color goes.

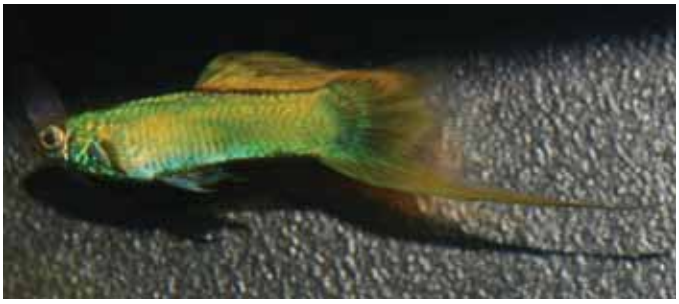
What can be observed about the Japanese Red Moscows, and other Moscow / Full Red crosses is that there is always an overall cast of bluish metallic color and some spotting in the fins. The fact that Oscar's F2 males showed blue and non-blue phenotypes suggests that this is a separate gene from the Y-linked head, front of the body and spotted fin gene complex. It may be autosomal. We are provisionally calling this gene the Bmt (Blue Metal Trait) gene. See the Blue Silverado entry for another discussion of this gene.

The issue of whether or not there is one full body red gene or numerous body zone red genes is discussed more fully in the Full Red article in the Notes.

Categories

Cat: Albino; Cat: Moscow; Cat: Full Red; Cat: Red

Emerald Green Lower Sword



Full Body Emerald Green Lower Sword. Picture by Finn Bindeballe. Taken at Dansk Guppy Klub show in the fall of 2007.

Description

This is an IKGH-conforming lower swordtail. See the article *IKGH* in the Notes.

Genetics

This guppy appears to be a full body version of the Emerald Green Iridescent gene. See the *Emerald Green Iridescent* article in the Notes. However, since the guppy does not show the characteristic black stripe, and the yellow and black spots of that gene, the attribution of this gene to this guppy must remain speculative. There is a possibility that another gene is involved, such as the full platinum gene.

The orange fins suggest the Red Tail (Rdt) gene is also involved.

See the Notes section for the genetics of the *Swordtail Fin Shape*.

This guppy has the following putative genotype:

$X^{(Rdt)(Ls)}Y^{(SmIr)(Ls)}$

Where Rdt = red tail fins, Ls = lower sword, SmIr = Emerald Green Iridescent

Categories

Cat: IKGH; Cat: European; Cat: Lower Sword; Cat: EGI; Cat: Red Tail

Variegated Lower Sword

Variegated Single Sword. Picture by Finn Bindeballe, taken at the Dansk Guppy Klub, fall show 2007.

Other Names

Bunt Single Sword. "Bunt" is German for multicolor or variegated. Could also be called Multicolor Lower Sword or Variegated Lower Sword.

Description

This strain should ideally have a sharper point to its lower sword.

Genetics

This strain may be descended from the Vienna Emerald Green. See the *Vienna Emerald Green* entry in the Color Bank.

See the Notes section on the *Swordtail Fin Shape*.

Categories

Cat: European; Cat: IKGH; Cat: Red Spots; Cat: Variegated; Cat: Lower Sword; Cat: Swordtail; Cat: EGI

Emerald Green Snakeskin Doublesword

Doublesword Green Snakeskin. Photo by Finn Bindeballe from the Dansk Guppy Club, fall 2007

Description

This guppy conforms to the IKGH standard. See the IKGH article in the Notes.

The guppy appears to have the Emerald Green Iridescent gene in combination with the snakeskin gene. It also has the bar gene in the peduncle.

Genetics

This guppy has the snakeskin gene. See the *Snakeskin General Information* article in the Notes.

It has the bar gene. See the *Bar and Zebrinus Genes* article in the Notes section at the end of the Color Bank.

What is interesting about this particular guppy is that it is expressing the Emerald Green Iridescent gene, the bar gene, and the snakeskin gene at the same time. See the *Emerald Green Iridescent* article in the Notes section at the end of the Color Bank.

See the Notes section for the genetics of the *Swordtail Fin Shape*.

The putative genetics of this strain is:

$X^{(Sst)(Ssb)(Ds)}Y^{(Ds)(SmIr)}$ bar/bar

Where Sst = snakeskin fins, Ssb = snakeskin body, Ds = doublesword X and Y genes, SmIr = Emerald Green Iridescent, bar = the bar gene

The black area in the front of the body may be a bandit marking. See the *Bandit Markings* article in the Notes section.

Categories

Cat: European; Cat: IKGH; Cat: Snakeskin, Cat: Doublesword; Cat: Swordtail; Cat: Green; Cat: EGI; Cat: Double Mutant; Cat: Bar Gene; Cat: Bandit Markings

Metal Speartail

Metal Speartail. Photo by Finn Bindeballe

Description
This is an IKGH standard speartail. See the Notes section entry for the *IKGH* standard.

Genetics
See the Notes section for the *Speartail Tail Shape*.

There may be a Emerald Green Iridescent spot at the base of the peduncle. See the *Emerald Green Iridescent* article in the Notes section. This is possibly a case where a metal gene and the EGI gene are co-dominant.

Categories
Cat: European; Cat: IKGH; Cat: Metal, Cat: Speartail; Cat: EGI; Cat: Double Mutant

Ruby Eye Super White

This version of a Super White has a form of albinism that allows it to partially display melanin in its eyes, called lutino or ruby-eye or wine-red. Picture is from www.x-b-r-e-e-d.com. Courtesy of Uthen Chaichot.

Other Common Names for Super White

RREA Super White, Triple Recessive, Genetic White, Albino White or Albino Super White

Description

This combination of recessive color genes is not capable of expressing black, red, or yellow pigments. The result is a fish that would be transparent, except there is reflective cells in the guppy that give it the appearance of a cloudy white color and some of the internal organs have structures that block the light. Reflective color cells, including iridophores and leucophores, are not affected (however see the note in the genetics section below). Blue highlights and blue fins also appear on this fish. Some iridophores have crystals the right size, angle and distribution to reflect the blue light waves.

The Super White phenotype is a pure white body with no yellow coloring. This is the result of the Asian Blau gene. See below.

Genetics

Super White guppies can be created by crossing guppies that carry the appropriate recessive genes: albino + blond (gold in the U.S. and Asia) + Asian Blau (often called blau or brao). The gene notation is:

a/a ; b/b ; Nb/Nb

Where a = albino; b = blond; Nb = Asian Blau

The Asian Blau allele is autosomal dominant (See *Autosomal Dominant* in the Common Genetic Terms section of the Genetics Appendixes.) When it is homozygous (Nb/Nb), it produces a white phenotype. When it is heterozygous it produces a blue metallic phenotype.

Here is how the mutated genes affect color:

- **Albino**: causes black color pigment production failure in the homozygous state.
- **Blond**: causes black color cells to fail to develop beyond a certain size in the homozygous state.
- **Asian Blau**: red and yellow color pigment production fails in the homozygous state.

Note that the Asian Blau mutation is homozygous. Homozygous Asian Blau appears to have an affect on the iridophores and black color cells in the body. If you out cross to another strain, with the intention of inbreeding again to recover the Super White genotype, choose the pure white (no yellow) progeny, as these will be homozygous for the Asian Blau mutation. Using one of the other so-called European blau mutations (r1 or r3) will produce a guppy with a different genotype.

Obviously the question mark here is the necessity for a blond recessive gene. Presumably the albino gene would cause a complete failure of black pigment to be produced. The blond gene causes the melanophores to fail to develop, making them too small to see with the naked eye. With no color cell blocking the path of the light, the guppy is rendered transparent, just as you see in the picture.

An additional aspect would be the presence or absence of leucophores and iridophores, which are white pigment color cells. These types of color cells would make the body opaque. Leucophores would make the body a dull white, whereas iridophores would make the body an iridescent or metallic white. You can see the effect of iridophores in the fins of the above guppy. The blue iridophores reflect the blue part of the light spectrum.

Categories

Cat: Albino; Cat: Asian Blau; Cat: Blond, Cat: WREA; Cat: Double Mutant; Cat: Triple Mutant; Cat: White

Snow White (White Platinum Pink White)

Snow White (Tomoko Young)

Other Names
White Platinum Pink White.

Description
The Snow White has a deep platinum white color with some greenish highlights. It has a deep white patch at the base of the peduncle and white fins.

Genetics
Tomoko Young has said Snow Whites are a development of Pink Whites. It appears the strain is a combination of Pink Whites and white platinum. However, the presence of yellow xanthophore color cells can give it a greenish hue. See the *Green Platinum Pink White* entry for a guppy with similar genetics. Take away the red tail allele and reduce the amount of yellow xanthophores and these two strains would look very similar. The genetics for this strain is likely:

XY^{P} Pw/-

Where P = Platinum, Pw = Pink White

The forward slash and dash indicates the autosomal Pink White allele is dominant. Note that the Platinum allele can be X- or Y-linked. It may or may not be important. There may in fact be another allele involved in this strain to give its white platinum color. Possibly snakeskin? An allele that suppresses yellow and/or red? This needs testing.

Categories
Cat: Platinum, Cat: Pink White

Metal Head Snakeskin

Metal Head Snakeskin by Luke Roebuck

Other Common Names

Russian Metal Lace, Snakeskin Moscow

History

The Moscow Snake is actually quite similar to the original form of the Moscow, as it first appeared out of Russia. The early Moscows had mosaic tails. .

Description

The strain has a snakeskin pattern on the latter half of the body and a "metallic" head and blue metallic color in the front of the body. The snakeskin pattern can have either yellow or red background color.

Genetics

For general comments about Moscow genetics, see the *Moscow General Information* entry in the Notes section.

This guppy is the result of a cross between a snakeskin and a Moscow. Such a guppy adds strength to the argument that one of the main defining characteristics of the Moscow phenotype is a strongly Y-linked front of the body and head pattern that is dominant. The Moscow pattern is displacing the snakeskin pattern in the front of the body. Obviously a solid colored Moscow, like the Blue Moscow, is actually a mosaic of genes, not a single gene.

The genotype is:

$X^{(Sst)(Ssb)}Y^{(Mw)}$

Where Sst = snakeskin fins, Ssb = snakeskin body, Mw = Moscow

For a comparison to another metal head type guppy see *Metal Head Red Tail Snakeskin Roundtail.*

Breeders Comments
Luke Roebuck

Luke Roebuck comments on his strain: "This is an original Russian/German Red Metal strain that comes in two main lineages. The photos above are the new line from the out cross [ed. to a Lace Snakeskin] and are available here at Luke's Show Guppies. Successive generations are reverting to the original Red Metal Lace variety as well as the new yellow color variety but much larger and more fertile! Compatible cross for snakeskins. The original red strain is popular in the World Guppy Contest Shows. The original red variety is shown and bred by German Breeders."

Categories
Cat: Snakeskin; Cat: Moscow; Cat: Blue

Ribbon Half-Black Magenta

Philip Shaddock

Other Common Names
Half-Black Magenta Ribbon

History
This guppy is descended from a Singapore strain of Flamenco Dancers, out crossed to a Hawaiian Blue Moscow male. See the *Magenta* entry in the Notes section at the end of the Color Bank.

Description
This is a young Ribbon Half-Black Magenta (2.5 months). The ribbon trait consists of an extended, shark-like dorsal fin, and evenly extended gonopodium and pectoral fins. The extensive amount of magenta color on the body is a characteristic of the half-black magenta guppy. What is unusual about this particular form is the magenta stripe in the front of the body.

Genetics
See the *Ribbon or Giessen Fin Shape* entry in the Notes for a discussion of Ribbon genetics. The Ribbon allele is dominant. Lengthening of the male gonopodium makes Ribbon males unable to breed, so a non-Ribbon male must be bred to a female heterozygous for the ribbon gene (Rib/rib).

The color of this guppy is due to the sex-linked HB allele and the autosomal Magenta allele. The presence of magenta color in the peduncle, replacing black melanophores, is characteristic of the interaction between the Half-Black gene and the Magenta gene.

The genotype for a Magenta Ribbon (non-breeding) male is:

$X^{(Ni)}Y$ M/M Rib/-

The genotype for a male chosen for breeding is:

X(Ni)Y M/M rib/rib

The genotype for a female chosen for breeding is:

$X^{(Ni)}Y$ M/- Rib/rib

Where Ni = half-black, M = autosomal dominant magenta, rib = Ribbon autosomal recessive

See the *Magenta* entry in the Notes section at the end of the Color Bank for a more extensive discussion of magenta genetics.

Categories

Cat: Magenta; Cat: Half-Black; Cat: Platinum; Cat: Silver; Cat: Ribbon

Shadow Dancer

Shadow Dancer. Photo by Luke Roebuck

Description

Luke Roebuck comments on the Japanese origin of the name of this Moscow variation: "Sometimes the bodies become so black when the males are in mating condition that, against a black background, the fish almost disappears (camouflages) against the background, except for the brightly colored and contrasting fins. What you see is brightly colored variegated fins dancing around the tank!"

Genetics

This is one of the crosses that Japanese breeders have made with the Moscow. In this case the "Shadow Dancer" is a cross between a Japanese female grass guppy and a male blue Moscow.

The putative genetics of this strain is:

$X^{(Gra)}Y^{(Mw)}$

Where Gra = grass; Mw = Moscow

Breeders Comments

Luke Roebuck

"A cross between a Moscow male and any kind of leopard/grass female will eventually lead to a variation of what the Japanese call "Shadow Dancer" in their Full Metal Blue Glass Strains. Willi Kosa in Germany also has been developing Moscow Leopards which are a different form of "Shadow Dancer."

Categories

Cat: Moscow; Cat: Grass; Cat: Blue

WREA Japanese Red Tail Tuxedo

Guppy and picture by Tomoko Young

Description

This has long been a unique and very popular strain among Oafu Island, Hawaii breeders. Male offspring show multi color variations. Some show a yellow caudal. Females live for over a year and are very fertile.

For a discussion of red color cells, see the Notes section, *Xanthophores / Erythrophores: Yellow and Red Color Cells*.

Genetics

The WREA (wine-red eye albino) allele is autosomal recessive. Another name for the mutation is lutino. If you cross the grey version of this strain with a RREA (real red-eye albino) version of the strain, F1 will be all normal eye, F2 will have 25% RREA (Real Red Eye Albino). Compatible crosses include Japanese Redtail Tuxedos, Hawaiian Red (gray version).

You can see the faint color of the half-black allele in the peduncle area. (See the *Half-Black* entry in the Notes section.) This shows that some black pigment (melanin) is manufactured in the melanophores (black color cells).

It appears that the fins have the snakeskin allele (ssb). The fins also have the red tail allele (rdt). The strain may also have Full Red roots, but it is difficult to tell in the photo if the head is red. Certainly there appears to be red in the front of the body. A possible genotype for this guppy:

$X^{(Sst)(Ni)}Y^{(Rdt)}$ wrea/wrea

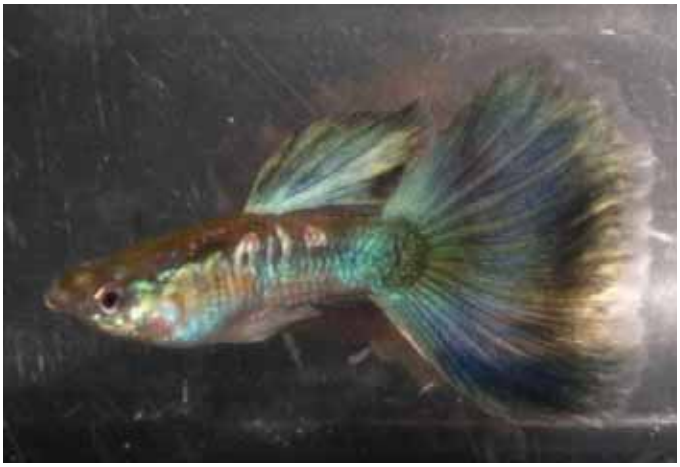
Where Ssb = snakeskin fins, Ni = half-black, Rdt = red tail, wrea = lutino or wine-red eye albino

It is not know what the red in the body is due to, an autosomal allele, an X-linked allele or a Y-linked allele.

Categories

Cat: Asian; Cat: WREA; Cat: Snakeskin Tail; Cat: Red Tail

Old Fashioned



Old-Fashioned Blue Tail from Tomoko Young's fish room. Tomoko acquired the strain from Bruce (Hsueh Tseng-Biao) in Taiwan. The strain comes from Japan.

History

The strain is said to originally come from Southeast Asia. According to Yasube, a Japanese member of the Guppy Designer forum, it is common knowledge in Japan that the strain got its name from a guppy shop staff member who liked the old rock group Three Dog Night song called, "An Old Fashioned Love Song."

Description

This is basically a Vienna Emerald Green phenotype with a delta tail instead of a swordtail.

The version show above has the blue tail gene, but the strain is more commonly seen with a mosaic caudal. Tomoko's strain has a delicate beauty somewhat lacking in the "traditional" Old-Fashioned strain, which is much closer to the Viennese Emerald Green in pattern. Doubtlessly the reason this strain is called "old-fashioned" is because the more typical pattern is closer to the wild guppy in its polychromatic variability than most modern strains.

Genetics

The old-fashioned gene is strongly Y-linked. The blue tail gene can be X- or Y-linked. You can create a version of this strain by crossing a Viennese Emerald Green double sword to a delta tail. As Tomoko's version shows, there is a lot of scope for experimentation.

The probability that the strain is descended from the Viennese Emerald Green Double sword is confirmed in a publication called the AF-Japan book. A visual inspection of the two guppies adds additional proof. See the picture of a VEG single sword on the next page.

Single sword VEG. Picture by Finn Bindeballe

You can see from the picture above that this guppy has the same Emerald Green Iridescent gene as the Vienna Emerald guppy.

The putative genotype is:

$XY^{(SmIr)}$

The interesting question is whether or not it has the Cp (Pigmentierte caudalis) gene to fill in the areas between the swords, or whether it just has the fin elongation genes to make it a delta tail. See the *Pigmentierte caudalis* entry in the Notes section. See also the *Emerald Green Iridescent* entry in the Notes.

Categories

Cat: Old Fashioned; Cat: Emerald Green Iridescent; Cat: Vienna Emerald Green; Cat: Asian; Cat: Japan

Albino Neon Blue

Albino Neon Blue. Picture by Bruce (Hsueh Tseng-Biao).

Other Common Names
Neon Blue Tuxedo

History
The Neon Blue is a product of Singapore breeders.

Description
The albino Neon Blue above shows that in the hands of a skilled breeder in Taiwan, quite ordinary guppies can be transformed into a strikingly beautiful guppy.

Doubtlessly the albino version of the strain shown above has been out crossed to strains with much finer fins and form compared to the original Singapore farm guppy. However, the basic genetics of the fish are the same, right down to the white patina you see on the head and back of this strain.

Pet store Neon Blue

The Taiwanese are not the only guppy breeders to go fishing at the fish farm. The Neon Blue is the foundation strain for the beautiful Japanese Blue Glass guppy. In fact you find a lot of Neon Blue genetics in Japanese blue strains, although the Japan Blue has more recently been used in crosses for its shimmering light blue quality.

The Neon Blue has the tuxedo (half-black) pattern.

Genetics

The base strain for this variant is a red half-black guppy! The neon blue color is a result of the Asian Blau mutation often referred to as "blau," the German word for blue. The mutation is also called the "r2" mutation in Europe.

When you acquire the Blue Neon guppy you acquire both the red and blue variations. That's because the Blue Neon is a hybrid, it has one Asian Blau allele and one normal allele. The blue metallic phenotype is created out of a Red Half-Black guppy by crossing it to a guppy with the Asian Blau mutation, variously called Silver in the U.S., Blau in Europe or Brao in Japan. ("Brao" is a variation in the spelling of "Blau.") Because the Asian Blau allele is dominant, you will always get a mixture of red and metallic blue phenotypes when the hybrid segregates out in the next generation.

The genotype for the guppy at the top of this entry is:

$X^{(Rdt)}Y$ Nb/nb a/a

Where Rdt= Red Tail, Nb = Asian Blue mutation, a = Albino

The Asian Blau mutation must be heterozygous in order to show the blue metallic phenotype.

Reference

For a more detailed description of the Asian Blau mutation and its breeding see the *Asian Blau Mutation* in the Notes section.

Categories

Cat: Asian; Cat: Asian Blau; Cat: Albino; Cat: Blue; Cat: Double Mutant

Medusa

Medusa. Photo supplied by Nico Roselli

Description

This guppy has a similar phenotype to the *Galaxy*. (See the Galaxy entry in the Color Bank.) However the caudal fin of the Medusa usually has streaks of red and yellow color.

This particular strain appears to be vertical bars in the peduncle, suggesting that the guppy has the bar gene.

Genetics

Presumably this guppy has similar genetics to the Galaxy. However the presence of the extra color in the caudal, and its poor shape suggest there is another gene or genes accounting for this strain's genotype.

For snakeskin genetics, see the *Snakeskin General Information* article.

Categories

Cat: Medusa; Cat: Snakeskin; Cat: Platinum; Cat: Bar Gene

Medusa Roundtail

Medusa roundtail guppies. Guppies and photo by Karen Koomans

Description

See the *Snakeskin Roundtail* entry for the proper shape of the caudal and dorsal fins in roundtails, according to the IKGH standard.

See the *Galaxy* entry for a discussion of the relationship between the Medusa and Galaxy guppy.

Genetics

Please see the *Medusa* entry for further information about the genetics.

The putative genetics for this strain are:

$X^{(Rndt)}YP^{(Sst)(Ssb)}$

Where Rndt = roundtail fin shape, P = platinum, Sst = snakeskin tail, Ssb = snakeskin body

The black area in the front of the body may be a bandit marking. See the *Bandit Markings* article in the Notes section. (It is even more obvious in the picture on the following page.)

Breeders Comments

Karen Koomans

I've bred this strain for about a year and a half. My initial stock was a mixture of longtail and shorttail guppies, the longtail ones looking like this:

Shorttail guppies were born exclusively out of females that showed a transparent line under their belly and throat. Another breeder of this type of guppy, Christiane Müsch from Germany, also reports on this typical female feature (see Faszination Lebendgebärende - Hochzuchtguppy Spatenschwanz Galaxy, web site in German).

Reference

For more information on roundtail genetics, see the *Roundtail Snakeskin* entry.

See the Notes article for the *IKGH* standard.

Categories

Cat: European; Cat: IKGH; Cat: Roundtail; Cat: Medusa; Cat: Snakeskin; Cat: Platinum; Cat: Bandit Markings

Albino Full Red Magenta

RREA Full Red Magentas by Hans-Peter Neuse

History
See the *Magenta* entry in the Notes section at the end of the Color Bank.

Description
The Full Red Magenta is the result of incorporating the magenta gene into a Full Red guppy strain. The guppy has an overall magenta hue.

Genetics
The magenta gene is said to be autosomal dominant. The version developed by Hans-Peter also has the albino gene in it. According to Hans-Peter, his cross became infertile. See the *Magenta* entry in the Notes section at the end of the Color Bank for a full discussion of magenta genetics.

Breeders Comments
Hans-Peter Neuse

Hans-Peter Neuse developed his version of the RREA (real red eye albino) Full Red Magentas from crosses between the European Flamenco Dancer and his own RREA Full Red guppy.

Categories
Cat: Magenta; Cat: Full Red; Cat: Red; Cat: Albino

Leopard Moscow

Photo by Hans Peter Neuse.

Description

The guppy has a Moscow blue body with spotted fins.

Genetics

The Moscow body colors and fin colors are due to different genes. This guppy definitively demonstrates this. Philip Shaddock has also produced a black Moscow with green fins and there is surely other examples.

The gene influencing the fins is likely to be snakeskin (sst). So the genotype of this guppy is probably:

$X^{(Sst)}Y^{(Mw)}$

Where Sst = snakeskin tail; Mw = Moscow.

It is possible that the snakeskin tail gene is on the Y-chromosome or on both sex chromosomes.

For general comments about Moscow genetics, see the *Moscow General Information* entry in the Notes section at the end of the Color Bank.

Categories

Cat: Moscow; Cat: Snakeskin Tail; Cat: Blue

Lazuli

This guppy was designed by Satoshi Kobayashi from the Osaka Kansai Guppy Club. Picture used with permission.

History

The Lazuli originated with Taketoshi Sue who works in Hiratsuka Bio Giken. The year it first appeared was 1999. The Lazuli Mosaic appeared in 2000. The Lazuli generated a tremendous amount of interest in the Japanese guppy press.

Description

The Lazuli gets its name from its color, the aquamarine blue of the Lapis Lazuli gem.

The Lazuli has long been described as a Japan Blue with extra genes for the color, particularly on the head. (A common name for the Japan Blue in Asia is Aquamarine.) This potentially makes the Lazuli as exciting a development in the guppy world as the Moscow, which also has a blue head. It joins a unique category, one that also includes the Singapore Neon Blue, the Full Red, and other strains. Robert Gall believes that the Lazuli is actually more related to Coral Red guppy (part of the Vienna Emerald Green family). See below.

Genetics

According to the late Yoshiki Tsutsui, the Lazuli has an additional color gene on its Y-chromosome for the blue head. The body is a different Y-linked blue gene. So it is similar to the Moscow in its genetics. The origin of the blue head gene is unclear. It might even be Moscow since the x-linked Japan Blue exists. But that is doubtful because the Lazuli was around before the x-linked Japan Blue.

A breeder of the Lazuli, Robert Gall, is a very knowledgeable and capable "guppy geneticist." His own breeding experiments cast doubt on the origins out of Japan Blue. Or maybe it is more exact to say that the Japan Blue and the Lazuli are "one mutation" or "one allele" apart. That is to say, they are part of a gene complex where one allele causes the phenotype to be either metallic red or metallic blue. Read Robert's

comments below.

Breeders Comments

Robert Gall

"The following comments reflect my experiences with lazuli and coral red, both of which I have bred.

The body color lazuli is only found to be Y-linked. This color appears as a bright blue on the fore body. This bright blue differs clearly from Japan Blue.

There are some striking similarities between lazuli and coral red. The intensity and the development of the lazuli is similar to coral red. In the fish room of Gernot Kaden, Pirna, Germany, several red males appeared among lazuli offspring of various lazuli delta and double sword types. These red "lazuli" were very similar to the different shades of red of coral red. Coral red combined with the Asian Blau effect appears bright blue, very similar to lazuli. So there are similarities.

Lazuli males seem to have, like coral red males, no trait for a dorsal coloration on the Y-chromosome. They do have double sword traits but these traits are not that good and equal to the traits of coral red (which differ from the DS traits of platinum strains or Vienna Emerald strains). Especially the spreading of the swords is rather bad.

When lazuli is combined with other body colors or patterns, it behaves in some cases similar to coral red. A combination of lazuli and X-linked snake skin leads to a combined pattern of lazuli and snake skin. It is very similar to a pattern of coral red and snake skin. The lazuli is reduced to a blue bar close behind the operculum. The rest of the body is covered by the snake skin pattern. A similar combined pattern can be observed on a guppy with the coral red and snake skin genes.

In contrast to coral red, lazuli is just a single trait: a bright blue coloration of the fore body. The coral red body color is a combination of at least two traits: a metallic red fore body and a poor light blue on the lower part of the peduncle. This light blue can also appear on males of other strains and is probably a recessive Y-linked trait of the Vienna Emerald trait-complex. Under special circumstances Vienna Emerald also show this trait on the peduncle. There is a doublesword strain which permanently shows this trait. It was a mutation in my Vienna Emerald strain and is now bred by Gernot Kaden. The dorsal coloration is lost, too. It shows that there is a relationship between the traits for the dorsal color and body color of certain strains.

An interesting observation is that Gernot Kaden's red "lazuli" also showed this poor light blue on the peduncle, which makes them appear even more like coral reds. The normal lazulis don't seem to show it.

Lazuli seems to be a similar gene/trait as the gene/trait for the metallic red color of the body color coral red. Whether the lazuli trait is just a variation of the gene for metallic red color of the coral red or is a similar but independent gene, can not be said yet."

Categories

Cat: Asian, Cat: Japan; Cat: Metal; Cat: Lazuli

Blond Magenta Moscow

Young Blond Magenta Moscow (2.5 months). Philip Shaddock

History

See the *Magenta* entry in the Notes section at the end of the Color Bank.

This particular strain is descended from the Asian Flamenco Dancer.

Description

This is a Magenta Moscow with the blond allele (called gold in the U.S.).

Genetics

See the *Magenta* entry in the Notes section at the end of the Color Bank for a complete discussion of magenta genetics.

The genotype for this strain is:

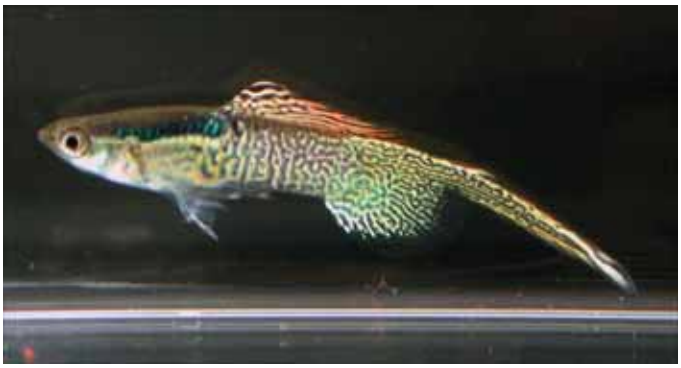
$XY^{(Mw)}$ b/b M/-

Where Mw = Moscow, b = blond, M = magenta. The dash indicates the strain can be heterozygous or homozygous for the magenta allele, since the magenta allele is autosomal dominant.

Categories

Cat: Magenta; Cat: Moscow; Cat: Blond

IFGA Snakeskin Swordtail



IFGA Snakeskin Sword. Photo: Philip Shaddock

Description

The IFGA Swordtail standard produces a thicker bodied, less aerodynamic shaped guppy compared to the IKGH (European) standard. The guppy in the picture is a an Upper Sword. The dorsal fin should be longer.

Genetics

See the *Vienna Emerald Green* entry for information on breeding swords.

See the *Red Lace Snakeskin* entry for information on breeding snakeskins.

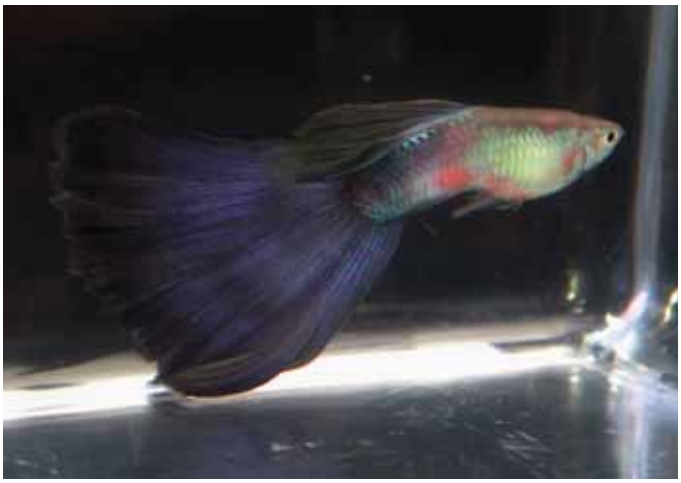
References

See the *IFGA General Information* page for information on the IFGA, its standard and breeding practices.

Categories

Cat: IFGA; Cat: Swordtail; Cat: Snakeskin

IFGA Purple



IFGA Purple. Photo: Philip Shaddock

Description

Purple is a combination of blue reflecting iridophores (reflecting color cells) overlaid with red color cells. The color purple is created by two color cells in the skin:

- blue light reflecting iridophores
- red pigment color cells (erythrophores)

The iridophores producing the blue color are in the middle layer of the skin. The red color cells are above, acting like the color gel on theater lights. The mixture of blue and red light produces purple color. Because these two colors segregate separately, the quality of purple is affected by the density and distribution of these two types of color cells. For information on red color cells that produce the red color, see the *Xanthophores / Erythrophores: Yellow and Red Color Cells* entry in the Notes section.

Notice the red spot in the peduncle area. See the article on guppy *Red Spots* in the Notes section.

The American breeder and guppy judge Tom Allen describes "silvers" appearing in his purples.

References

See the *Half-Black Purple* entry for additional comments about the Purple color and strain.

See the *IFGA General Information* page in the Notes section for information on the IFGA, its standard and breeding practices.

Categories

Cat: IFGA; Cat: Purple; Cat: Red Spots

IFGA Pastel

IFGA Pastel. Photo: Philip Shaddock

Description

The Pastel is a guppy that is homozygous for the blond gene (bb) (gold in Asia and U.S.). The name derives from the fact that the absence of black pigment layer at the bottom of the skin means light is reflected back out through the skin, washing out the yellow, red and blue iridophore colors to a pastel "light" and unsaturated color.

Rick Grigsby, a prominent breeder of the strain, says that the strain also has a darker, more gold version.

Hans-Peter Neuse says the fish pictured above is called "bunt" in Europe, which means "colored." He suggests that in Europe it would be described as a "multi-pastel."

These pictures show a "white" and "yellow" version from Luke Roebuck's fish room:

Luke Roebuck White Pastel

Yellow Pastel

Luke comments on the two pictures just shown: they "came from a variant from Rosenberry from the Pasadena Texas Guppy Club. They were crossed to Alderson HB Pastels. They tend to erase the problems of the original strain dorsal, which had better color than the caudal. You can see the "ghost" of the Half black body faintly visible in the males. These fish are maintained by Hermann Magoshitz of Germany as well as myself. Hermann won the WGC 2001 Grand Points overall with the strain. They get fairly large and have great fin shape but can have some dorsal shape problems."

Genetics

The blond (bb) allele is recessive and the body color is inherited like other recessive body colors. The golden gene (Tiger in Asia, gold in Europe, bronze in North America) is dominant over this body color.

Nine out of ten IFGA Pastel strains have the half-black allele (Ni) on the X-chromosome.

Breeders Comments

Dave Polunas

The IFGA breeder Dave Polunas has been breeding them since 1982. His strain was originally yellow, but became progressively whiter. He recommends line breeding Pastels to maintain them. Polunas considers the Pastel to be a great strain for crossing, presumably because of its simplified color structure, lack of half-black pattern and lack of other patterns and colors.

Rick Grigsby

Rick Grigsby comments on the breeding of the gold version of his Pastels. "Very interesting fish with some very nice qualities. Most are blond, although some have more of the gold [ed. blond] expression (which by the way, does not breed true in either strain I have.) Really odd considering that inheritance of gold coloration is supposedly recessive. I do know this, when crossed with normal "grey" strains, all offspring are 100% "grey". When sibbed, F1 x F1, you get almost 25% of the "blond" coloration in the fish, but no golds until inbreeding the blond F2 xF2, then you get a small proportion only."

References

See the *IFGA General Information* page for information on the IFGA, its standard and breeding practices.

Categories

Cat: IFGA; Cat: Blond; Cat: Red Spots; Cat: Pastel

IFGA Half-Black Yellow

Picture by Philip Shaddock

History

The Half-Black Yellow strain was originally developed by Gerhard Gellrich from Frankfurt in Germany in the 1960s, where it is small compared to its American descendants. It was imported to America at the beginning of the 1970s and was probably crossed with the large-bodied Half-Black Pastel females to purify the yellow color and produce larger versions. The strain was exported to Japan where it became very popular. It was eventually lost in Germany, so the Half-Black Yellow was imported back to Germany by Claus Osche in the early 1990s. Gellrich also developed the HB White.

Description

Half-Black Yellows that do well by IFGA standards tend to have fins that are a matching light "butter yellow" color, evenly distributed throughout the fins. It is possible to get nice squared off delta shaped caudals with this strain as well as long flowing dorsals. The peduncle should be a shoe polish black color. Judges also pay attention to where on the body the half black color begins and ends. You don't want black extending forward beyond the start of the dorsal and you don't want any black bleeding from the peduncle into the caudal fin. The usual size, shape and deportment considerations go without saying.

See the article on the color yellow in "*Xanthophores / Erythrophores: Yellow and Red Color Cells*" in the Notes section.

Breeders Comment

The strain is difficult to breed to show quality standards because the color yellow is easily overshadowed and is darkened by intermixed black pigment. Yellow guppies have an abundance of xanthophores, (yellow pigment cells). After repeated inbreeding, the light yellow may be difficult to maintain. half-black pastels are

commonly used by advanced breeders to clean up the fin color of the half-black yellows by various crossing techniques.

At least one breeder notes that the smaller yellow males produce young with purer, lighter yellows than larger males.

Another problem that crops up with the Half-Black Yellow strain is that the black tends to bleed into the caudal if inbred too long. Size tends to dwindle quickly with successive generations so it is recommended that the breeder keep at least three lines of these going at once: one line for color, one for shape and one for size. Many people won't bother with this strain because of the amount of tank space required to raise them, because to do it correctly will require at least 18 tanks to properly maintain them to show standards. Some breeders recommend using Half-Black Pastels to "clean-up" the yellow on this strain. You need to find strains that have the half-black gene on the Y-chromosome and not the X-chromosome. If doing a cross to avoid the half-black pattern, use gray females from these strains. However, this is a risky cross if you do not know the genetic background of the two strains. The problem is that the Half-Black Pastel color genes are dominant to the Half-Black Yellows. Some breeders report good success crossing gold bodied Half-Black Pastels to the strain of Half-Black Yellow that needs improvement. Try to use the Half-Black Pastel males that have any amount of yellow in the fins for best results. If the fry from the cross grow up and look good and you are satisfied, breed these f1 fry males back to your original line females and start your new lines from those females or breed the F1 siblings from the cross to each other and start your two lines from there. If you have the tank space, you can breed back to your original line and breed the siblings to each other and choose the fry that give the best results. Most people who show their half-black yellows and win, will also have a compatible half-black pastel strain on hand to cross into whenever they see a decline in their half-black yellows.

Genetics

Nine out of ten Half-Black Yellow strains have the half-black allele (Ni) on the X-chromosome. See the Notes section for a discussion of the *half-black* allele.

References

See the *IFGA General Information* page for information on the IFGA, its standard and breeding practices.

Categories

Cat: IFGA; Cat: Half-Black, Cat: Yellow Tail; Cat: Yellow

IFGA Half-Black Red

Picture by Philip Shaddock

History

IFGA Half-Black Reds have their origins in strains developed by Stan Shubel and Paul Gorski. Jim Alderson, who derived his stock from these early strains, has been a recent notable breeder of reds.

Description

The challenge provided by this strain is maintaining the intensity and density of the red and the deep black of the half-black pattern simultaneously while selective breeding. Black spotting creeps into the dorsal, and the red fins can become muddied, developing brown tones. Similarly, the half-black pattern can become weak, washed-out and lose its clear line of demarcation between the front and back parts of the body at the dorsal leading edge. You can see in the picture above that the half-black pattern has spread into the front part of the body. The following discussion assumes a Shubel / Alderson heritage in the lines you are breeding.

The red color is chemical and is affected by the food the guppy eats. It has long been believed that foods with carotenoids (which the guppy cannot synthesize de novo) help the guppy store red pigment. For example, brine shrimp is said to deepen the reds of Half-Black reds or other red strains. However the scientific literature suggests that a redder guppy may simply be a healthier guppy. The other chemical in red is pteridine. It is synthesized de novo, so it is not derived directly from food.

Genetics

Red Genetics

There are at least six different red genes, accounting for the variation you see in the color on different red guppies. Some believe the red is additive and multigenic. The more red genes involved, the redder the guppy. The fewer red genes, the pinker the strain. This has been disputed by others. However, given that there are

two red pigment organelles in red guppies, one containing carotenoids and the other containing pteridines, there must be more than one gene involved.

Half-Black Genetics

The half-black gene is usually found on the X-chromosome, although some rare strains may have the gene on the Y-chromosome. The red gene that most affects this strain's red color is likely located on the Y-chromosome, which explains why selecting the female for her red color is not important. In some strains the best female is not the one with the darkest red fins, but rather with pink or lavender fins with a slight mosaic pattern. In fact, the female should probably be picked for form and intensity of half-black pattern. Select the females with the thickest peduncles and the best overall shape. Jim Alderson usually advises to select the females showing the darkest half-black pattern, regardless of fin color. Improving the red color is usually accomplished by breeding blond-bodied (bb) Solid Red males with gray-bodied Half-Black Red females. This produces an excellent F1 generation, all half-black. The males are then bred back to original Half-Black females. It's critical that the female with the darkest half-black pattern be chosen, since this cross does tend to lighten the half-black pattern, even as it is cleaning up the red color. The females from the F1 generation of this cross can be used to create a new gray-bodied Solid Red line. They are bred to homozygous (pure) blond (bb) Red males (called gold in the IFGA). The F1 drop of this cross will yield about 25% gray-bodied (bB) Solid Red of excellent quality. Half-Black Reds are also crossed with Red Albinos.

Crossing a male Half-Black Red with a Red Albino female produces an F1 generation that is gray-bodied Solid Red (assuming both parental strains are homozygous). The red will be rich and dark. The fins will be excellent. Crossing the other way (male Red Albino to female Half-Black Red) is not as productive. The F1 generation is all Half-Black red. If spots have been a problem with your line, and the parental generations were good, this cross may clear up the spots.

Using bi-color or multicolor guppies with red in them is not usually a good idea, unless you have a long time horizon and lots of tank space. The pattern, once bred into your line, is very difficult to get rid of.

References

See the *IFGA General Information* page for information on the IFGA, its standard and breeding practices.

Categories

Cat: IFGA; Cat: Half-Black; Cat: Red

IFGA Half-Black Purple

Photo by Philip Shaddock

Description

Most IFGA Purples that you see on the show bench tend to look very dark, almost black. There is a lot of black pigment alongside the purple pigment. The color purple is composed of red pigment color and reflected blue light.

Color Structure

The color purple is created by two color cells in the skin:

- blue light reflecting iridophores
- red pigment color cells (erythrophores)

The iridophores are in the middle layer of the skin. The erythrophores are above, acting like the color gel on theater lights. The mixture of blue and red light produces purple color. Because these two colors segregate separately, the quality of purple is affected by the density and distribution of these two types of color cells.

Genetics

The strain has the half-black allele. See the Notes section for an extensive discussion of the *half-black* allele.

Breeders Comments

The strain is cross-compatible with blues and greens. Green is a somewhat better cross than blue. The cross to blues tends to produce dark Half-Black Blues or almost black Half-Black Purples. One breeder suggests that the cross between Greens and Purples works both ways. Purple is dominant over green. The cross also produces a portion of Blues. To improve the Purples, cross a Purple male with a Green female. Back cross to the Purple line, choosing a Purple female from the hybrid cross. To do that, darken the lights in the fish room and shine a flashlight on the females. There will be green and purple females, showing green and

purple crescents at the base of the peduncle respectively. With regard to the Half-Black Purples, the purple color tends to become darker as the breeder selects for a dark half-black pattern. If the breeder does not maintain one line for light purple color on the fins and another line for dark half-black pattern, he or she might find themselves breeding the light purple color right out of the strain. They will then have to go to an out cross to try to lighten the purple color. As is the case for most Half-Black strains, the female is key. In most Half-Black Purple strains, she carries the half-black gene. She can also affects the darkness (blackness) of the male's tail. The breeder should choose females who have the darkest half-black pattern and the lightest tails. Better still is to maintain two lines, one focused on the half-black pattern, the other on the light purple color. Cross one to the other to correct problems as they arise. The breeder Kwartler provides the following advise in choosing females. Look at the area between the pectoral fins and the gills for purple color. These females will produce better purple sons. Other females will show pale blue or green in this area. The best out cross is to a solid Purple strain. A Purple male is bred to a Half-Black female with the darkest black half-black pattern and the cleanest tail. This hybrid cross can produce show winners.

Tom Allen, the American senior IFGA judge, has found what he calls "Silvers" in his drops. Presumably he means guppy with a silver color. These are undoubtedly guppies with a mutation affecting either or both of the red and yellow color cells, or possibly what is called "the Asian Blau mutation." The effect of the Asian Blau mutation when heterozygous is the conversion of red color cells to blue iridophores. This latter mutation would presumably have the effect of making guppies with the heterozygous mutation less red and more blue.

See the *Asian Blau Mutation* entry in the Notes section at the end of the Guppy Color Bank.

See the entry for *IFGA Purples* for additional comments.

References

See the *IFGA General Information* page for information on the IFGA, its standard and breeding practices.

Categories

Cat: Half-Black; Cat: Purple; Cat: IFGA; Cat: Red Spots

IFGA Half-Black Pastel

This Half-Black Pastel was part of a tank entry that won first place in an IFGA show. Photo: Philip Shaddock

History

The first Half-Black Pastels came as Half-Black Whites from a breeder in Germany (Frankfurt), Mr. Gerhard Gellrich. He shipped his new strain to the U.S. sometime around the end of the sixties. At the same time he shipped some to Japan. The modern strains have descended from these originals.

The Half-Black Pastel may have originated out of Europe, but its huge size and spectacular, showy fins were developed in America. It is a favorite among breeders in North America. A single tank of Half-Black Pastels can draw attention from across the room.

Description

The IFGA Half-Black Pastel is basically a gray or gold bodied half-black guppy with white fins. There are blue iridophores in some strains, giving them a pale bluish tone. The half-black pastels that have done the best on the IFGA show bench over the past ten years are the type with pure white fins, although those with the bluish hued white fins do well during certain show years as demonstrated by the one pictured above.

This particular strain has a red spot in the front of the body. See the Notes article on *Red Spots*.

Genetics

This strain has a number of genes in it's make-up, including the half-black gene that gives it the half-black peduncle. See the Notes section for an extensive discussion of the half-black allele.

Most H/B pastels seen on the IFGA show bench are the F1 generation hybrids from recent out crosses, since this strain tends to get very small, very quickly without the regular infusion of new gene stock.

Breeders Comments

The IFGA Half-Black Pastels have perhaps one of the tightest and most stable genetics. They are often used in crosses because of this. However, ironically, they are not easy to breed because the purity of the pastel color on the fins is easily lost.

An American breeder of this strain, Bill Klein, devoted a huge number of tanks to the strain. He reports that the percentage of good breeders coming out of a drop is extremely low, less than 5%.

The American breeder and former Half-Black Pastel champion, E.T. Mellor, has tried to improve his line with a Japanese Half-Black Pastel strain. However there was a loss of size in the cross and by the time the size was regained, the Japanese influence was lost. In his American line, E.T. Mellor also found spots on the fins to be a problem. He selects males without the spots, obviously. Other breeders have reported clear areas showing up in the dorsal.

Another problem plaguing many Half-Black Pastel lines is infertility and a decrease in size after a couple of generations of close inbreeding. E.T. Mellor typically gets a maximum of three drops from his breeder females. Some females prove to be infertile.

Some breeders use the Gold (gg) Half-Black White to increase the size and fins of their grey-bodied line and to fix the fertility problem. A Gold (gg) Half-Black White male is bred to a grey Half-Black Pastel female. This produces washed-out offspring. The best of the males are selected from the cross and bred to Gold (gg) Half-Black White females. This is said to produce a bigger, more vigorous line.

Half-Black Pastels benefit from a good line breeding program. At a minimum keep two lines going, crossing brother to sister for three generations and then crossing the lines. When selecting male breeders, the largest bodied males are not the best choice as they often have fertility problems. Use the largest females to maintain size. Steve Kwartler recommends that the aquarist introduce their male and female breeding stock to each other at the three month mark of development, as older virgin females become harder for the males to impregnate.

The Half-Black gene is most often found on the X-chromosome. The half-black pattern on IFGA strains often is "converted" to leucophores in some European or Japanese strains. The leucophore pattern is usually Y-linked, although X-linked versions have recently appeared.

The Half-Black Pastel male is sometimes bred to lace Snakeskin females with the snakeskin pattern on the X-chromosome. This produces Half-Black AOC offspring with poor spotted patterns. The American breeder Luke Roebuck prefers to do the cross the other way. He suggests the lace snakeskins are preferable to those showing the Cobra pattern, as the lace pattern is more recessive. "A good Russian Metal Lace may be even better because the metal head would control the surface area expression of the half-black color to about 50%, which is desirable." Luke is referring to the member of the Moscow family that has the Moscow blue on the front part of the body and Snakeskin pattern on the second half.

Categories

Cat: IFGA; Cat: Half-Black; Cat: White Tail; Cat: Red Spots; Cat: Pastel

Red Moscow

Moscow Red. Guppy by Hiroshi Nishimura.

Moscow HB Red. Guppy by Takahiro Mizuguchi.

Luke Roebuck's Moscow Red

Other Common Names
Moscow Half Black Red

History
Please add your comments.

Description
A Red Moscow is simply a Moscow with a lot of red color cells and few iridophores.

Genetics
For general comments about Moscow genetics, see the *Moscow General Information* Notes article.

Breeders Comments

Nishimura and Mizuguchi

The two Red Moscows shown at the top of this article were bred by two members of the Osaka BBC/ABC/Kansai guppy club, Hiroshi Nishimura and Takahiro Mizuguchi. The top picture shows a Full Red Moscow and the bottom shows a half-black Red Moscow. Both Moscow strains originated from a cross between a Moscow Blue and American Full Red and Half-Black Red guppies. The Moscow Reds represent new strains from Osaka (Kansai Area). Takahiro Mizuguchi, who has been working with Moscows since the mid-nineties, says the original Blue Moscow strain he acquired came out of Eastern Europe. He says there was a lot of red color pigment in the original import stock. Crossing red guppies into the Blue Moscow enhances the red pigment. Crossing American delta blues fades out the red. Apparently Mizuguchi substantially agrees with the theory that the Moscow has its origins in the snakeskin gene complex.

The first Moscows that arrived in Japan were apparently had the golden gene. One of the other Japanese breeders created Purple Moscows from U.S. purple deltas using the tiger version of the strain. Breeders of Full Body Reds in the West should experiment with the Moscow cross...

Atsunori Hoshimoto very kindly supplied us with the information and pictures on this page. We would also like to thank the Moscow Red breeders.

Categories

Cat: Moscow, Cat: Red

Silver-Banded Moscow

Silver Banded Moscow bred by Philip Shaddock

History

This strain was developed by Philip Shaddock. It originated out of Hawaiian Blue Moscows imported from the U.S. and crossed with a female Blue Galaxy, also imported from the U.S. The Hawaiian Blue Moscows harbored a golden (Europe Gold, Asia Tiger, U.S.A. bronze) gene.

Description

It has a solid green body, with areas broken by silver and black markings.

Genetics

For general comments about Moscow genetics, see the *Moscow* entry. The strain is the result of a Golden Blue Moscow to female Blue Galaxy cross. The female Blue Galaxy had the Asian Blau mutation (called r2 or Asian Blau in Europe).

The genotype is:

$X^{(Ssb)}Y^{(Mw)}$ Nb/nb G/g

Where Ssb = snakeskin body, Mw = Moscow, Nb = Asian Blau, g = golden

Note that the golden and Asian Blau alleles are heterozygous. The golden gene seems to alter the expression of the snakeskin / galaxy gene complex. The non-golden siblings to the Silver Banded Moscow look like normal Blue Moscows.

Categories

Cat: Snakeskin Body; Cat: Moscow; Cat: Asian Blau; Cat: Golden

Panda Moscow

Photo by Finn Bindeballe

Pink Moscow by Karen Koomans.

Pink Moscow female by Karen Koomans.

History

Yoshiki Tsutsui is said to have done the first Pink X Moscow cross. He named his creation the "Panda Moscow."

Description

The Panda Moscow shows the competing influences of the Pink guppy and Moscow guppy, with a mixture of white and black / blue areas of color. The black eyes and the white front of the body are markings that

give this guppy its name, resembling as it does the Panda Bear. Generally Pandas tend to be smaller than either strain they descend from. They have round short tails, although delta tails have been reported by some. European versions of this strain may have snakeskin markings on the peduncle, visible in the Koomans Pink Moscow above. This may be due to linkage of the snakeskin gene on the same chromosome as the Pink. (See the Notes article on linkage.)

Genetics

The strain is the result of crossing a male Moscow (Y-linked) with a female Pink (autosomal recessive).

Genotype: $XY^{(Mw)}$ k/k

Where Mw = Y-linked Moscow, k = autosomal recessive pink

Categories

Cat: Pink; Cat: Moscow; Cat: Panda

IFGA Half-Black Green

Alderson HB Green. Photo and Guppy by Philip Shaddock

Description

In this particular version of the IFGA HB Green strain, the females tend to vary from very dark grey to very black.

This strain has a red spot in its front of the body. See the *Red Spots* article in the Notes section at the end of the Color Bank.

Genetics

Green color in guppies is due to yellow pigment color cells (xanthophores) and iridophores (blue light reflecting metallic color cells). Green color in guppies is due to yellow pigment color cells (xanthophores) and iridophores (blue light reflecting metallic color cells), so green is under the control of at least two independent genes.

This guppy carries the half-black gene. The blackness of the female makes it likely that the HB allele is the NII version. See the Notes section *Half-Black or Nigrocaudatus PI / PII* article for a description of this allele.

The green color in the fins of this strain is due to x-linked yellow color cells and iridophores.

See the Notes section for an extensive discussion of the *half-black* allele.

Breeders Comments

Philip Shaddock

As is the case for most Half-Black strains, the female is key. She can also affect the darkness (blackness) of the male's tail. The breeder should choose females who have the darkest half-black pattern and the lightest tails. Better still is to maintain two lines, one focused on the half-black pattern, the other on the light green

color. Cross one to the other to correct problems as they arise. See Dr. Alderson's breeding tips below.

This particular strain of the HB Green guppy has a gene called the Onyx gene (so named by Dr. Jose Rene Berrios). The autosomal recessive gene was used by Dr. Alderson to deepen the black peduncle of the strain. The females in a drop can vary from a female with a moderately black peduncle to a female that is jet black from the nose to the tail, with only the belly in silver. I have transferred the gene to other strains. A black Moscow was created that does not fade on the judging bench, as well as a "two-tone" black Moscow with a black body and green fins. The female HB Green was used to create my Pacific Blue Moscow strain.

Dr. Jim Alderson

I have used the Moscow females to cross into my blue and green males. I always get a darker peduncle (sometimes HB) with enhanced coloration and frequently get fish similar to what you describe. The F1 turn out quite nice, winning blue tank at a couple IFGA shows. However, the sib F2 cross will often start to break down or segregate into strains used to make the parent strains. I have thrown out a lot of the offspring from F1 Moscow sib crosses. The cross will improve color and vigor, but frequently begets rounded caudal corners, a non parallelogram dorsal and elongation in the body from the dorsal fin to the caudal peduncle, which doesn't bode well for large caudals. If I do out cross to a Moscow female, I now take the F1 females back to males of the non-Moscow parent strain. This tends to maintain the color and vigor without the aforementioned problems. I am not looking at individual genes or inheritance patterns, but more for breeding schemes that are reproducible and can maximize the improvement of my fish in the fewest number of generations. This was the technique used by Mike Lastella, one of the best guppy breeders I have ever known. He had many terminal crosses (hybrids), that he used simply for show and never to breed. While I don't have many terminal crosses I show, I do have several breeding schemes I have discovered and learned from other breeders that consistently improves strains much faster than sibbing them or line breeding them, which is what you need to do to study specific genes.

References

See the *IFGA Green* entry for more information on Greens. An IFGA Green is basically the same as a Half-Black Green, but without the half-black pattern or allele.

See the *IFGA General Information* page for information on the IFGA, its standard and breeding practices.

Categories

Cat: IFGA; Cat: Half-Black; Cat: Green; Cat: Red Spots

IFGA Half-Black Black

IFGA Half-Black Black. Photo Philip Shaddock. Taken at an IFGA show.

Description

This is a guppy that has black fins and a half-black pattern on the caudal.

This must be one of the simplest guppies in the world. It has black fins and a half-black pattern and a grey front of the body. It would be interesting to see what an albino version of this guppy reveals. A wild-type guppy?

Genetics

See the Notes section for an extensive discussion of the *half-black* allele. It is possible that this is an example of the guppy with NII allele.

References

See the *IFGA General Information* page for information on the IFGA, its standard and breeding practices.

Categories

Cat: IFGA; Cat: Half-Black; Cat: Black Tail; Cat: NiII

IFGA Half-Black AOC

IFGA HB AOC. Picture by Philip Shaddock. Taken at an IFGA show.

Other Common Names

This type of guppy is known as a Dragon Head or Leopard in Asia.

Description

The IFGA Half-Black AOC (Any Other Color) is known as the Dragon Head in Europe and some Asian countries, and the Leopard in Japan. The result of a cross between a half-black and snakeskin guppy, what distinguishes it is the snakeskin pattern in the front of the body and half-black pattern on the peduncle. This is a popular strain on the show circuit in North America and is usually recommended to beginners because its cross-bred vigor makes it hardier and bigger than other strains. It will retain these qualities longer than more inbred strains, and can usually go five or six generations before it needs to be line crossed or out crossed. Typically the black spot pattern is on a yellow or white background, but it depends on the colors of the snakeskin and half-black strains used in the cross. In IFGA judging, the spots should have good distribution and a round shape. The spots and the half-black pattern should be deep black. The spots should show excellent contrast with the background. The Dragon Head is a popular pet store guppy but like most fish farm-bred guppies it suffers from poor fin shape and size, when compared to show quality strains.

Genetics

Note that the snakeskin body and fins are due to two separate genes (Ssb and Sst). (See the *Snakeskin General Information* article in the Notes section.) To produce a HB AOC, you need to choose a snakeskin line that has both the snakeskin body and fins to produce a HB AOC with spotted fins.

The genotype for this strain is:

$X^{(Ni)}Y^{(Ssb)(Sst)}$

Where Ni = half-black gene, Ssb = snakeskin body, Sst = snakeskin fins

The color and pattern of the F1 will depend on what base colors of the two lines (HB and snakeskin) you employ in the cross.

Breeders Comments

A well-established IFGA Half-Black AOC strain should be true-breeding, meaning most of the offspring should be identical to the parents. If you want to make your own AOC line, the best cross is a male Snakeskin and a female Half-Black line. This assumes the female has the Half-Black gene. There is preference in American strains for males with no "Dragon Heads," that is, snakeskin patterns on the front of the body. This means you need to find a female half-black strain whose half-black allele is very black. (It is probable that the best allele is the NII. See the Notes section for an extensive discussion of this allele.)

Luke Roebuck suggests trying a Moscow strain showing the snakeskin pattern on the latter half of the body and a blue "metal" pattern on the fore part of the body, "because the metal head would control the surface area expression of the HB color to about 50%, which is desirable." Pay particular attention to the quality of the snakeskin. Some of the older snakeskin lines suffer from a small dorsal or short caudal. When you have crossed the snakeskin male to the half-black female, take the best male from the offspring and breed him back to the half-black female line. Once you have your new strain established, every fifth or sixth generation breed a male back to the X-linked half-black female line. This means that to maintain a half-black AOC line, you should have room for a second half-black strain. Good half-black strains to use to maintain the white background color on half-black AOCs are blue, purple, yellow or lavender. You may need to experiment with various snakeskin lines to get a good spot pattern on the fins, rather than swirls or splotches of color. This makes it important that you use true-breeding half-black and snakeskin lines to gain control over the variations produced in subsequent generations.

Iwasaki, in Fancy Strains and How to Produce Them, says that in maintaining the Japanese Leopard strain [ed. equivalent to the HB AOC], use a King Cobra [i.e. snakeskin] female. You can also crossbreed with Yellow Grass, keeping the fry that most resemble the Leopard, and breeding them back to the Leopard. Do not use guppies with red coloration in the caudal fin. Select simple Leopard females with round, clear tails.

The scientist Dr. Gideon Khoo in Singapore has made an interesting observation about this cross. In a lecture he gave in 2005 at the University of Singapore, he pointed out that the BCP gene (which colors the peduncle and caudal fin black) causes the snakeskin pattern in the fins to become coarse black dots. Indeed, if you look at the picture at the top of this entry, this is what happens when an American half-black strain, presumably with the Ni half-black gene, is crossed with a snakeskin. The snakeskin pattern in the fins become coarse dots.

References

See the *IFGA General Information* page for information on the IFGA, its standard and breeding practices.

Categories

Cat: Double Mutant; Cat: Half-Black; Cat: Snakeskin; Cat: IFGA

IFGA Green

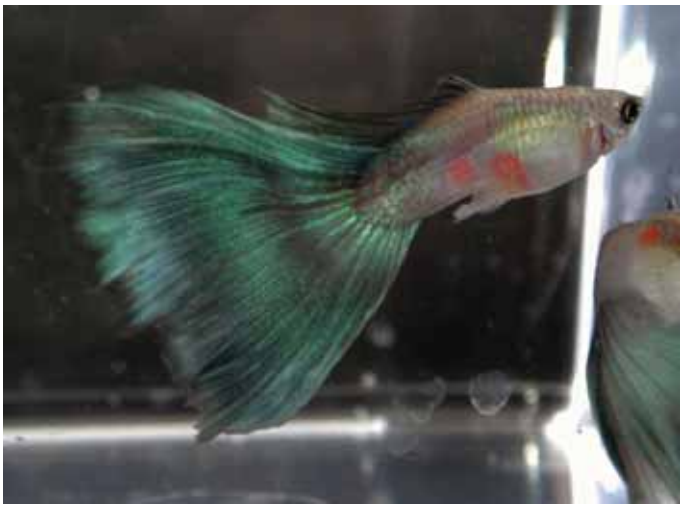


Photo by Philip Shaddock. Taken at an IFGA show.

History

Parish Green

Stoerzbach Moscow

IFGA Greens are an old strain. And one of the oldest Green strains is the "Parish Green." This strain was originally characterized as large and hardy, although inbreeding has probably changed that. The breeder Hutter developed a green with a matching dorsal, which was further developed by Regent. Hutter greens tend to be smaller and more brilliant in color, and less hardy. "Parrish Greens" is a term that often refers to guppies with white spotting or streaking in the dorsal, while "Hutter Greens" have come to refer to greens with matching dorsals.

Description

This must be one of the most DQ'd (disqualified) guppies at the IFGA shows. The green guppy in the breeder's tank appears under the show lighting as a blue or purple guppy. The reason lies in the color

structures in the guppy's skin. The green color is a combination of yellow pigment and reflected blue light bouncing off the guppy's iridophores. The angle and color temperature of the show lighting reflecting off the iridophores can change the apparent color of the guppy. Because judges have to evaluate with their eyes, not with their preconceptions, a Green under unnatural lighting conditions at shows often does not show enough green color to qualify.

Although there are full body green guppies in other parts of the world, the non-IFGA green tends to be more metallic. The IFGA Green metallic blue is weak and scattered, creating a thinner and duller green. It thins out to grey towards the front of the guppy.

Stoerzbach Moscow showing a metallic yellow green color.

The presence of red spots in the peduncle is typical of the strain. See the Notes section on *Red Spots*.

Color and Genetics

The Green guppy has three main layers of color: black, structural blue and yellow. The black melanophores are at the bottom and act as a sponge for light. The structural blue iridophores are above the black layer and reflect blue light. The topmost layer is composed of yellow color cells. Green is blue light mixed with yellow light. The more reflective color cells (iridophores), the bluer the shade of green. The more yellow color cells, the more yellow the shade of green. And the more black color cells, the darker the shade of green. When the reflective layer becomes thick and slightly disorganized you get a metallic green guppy like the Stoerzbach Moscow above.

These three color cells tend to assort independently in a cross. So the IFGA Green is cross compatible with yellows and blacks. Some IFGA breeders use Greens to improve the yellow color on IFGA Yellows. This is because the IFGA Green has a lot of yellow pigment. In a cross the yellow pigment will sort independently, producing some IFGA Yellow guppies with more yellow pigment as a result of the cross.

The red spot in the lower half of the peduncle is discussed in this Note.

Breeders Comments

Because of the size and classic fins of the Greens, and because the green colors (yellow pigment and structural blue) are recessive to most other colors, the Green guppy female is often used to increase size and improve fin shape in other strains. In particular, it makes a compatible cross with blues (3 out of 5), purples (5 out of 5), snakeskins (4 out of 5) and HB AOC (3 out of 5). (Values on the Alderson compatibility chart.) Reds are not compatible with Greens.

Crossing with Purple strains darkens the Greens. Therefore, the lightest colored Green males should be crossed with Purple females. Use a flashlight to find Green females in the offspring. The Green females have a green crescent at the base of their caudal.

As is the case for most Half-Black strains, the female is key. In most Half-Black Purple strains, she carries the half-black gene. She can also affect the darkness (blackness) of the male's tail. The breeder should choose females who have the darkest half-black pattern and the lightest tails. Better still is to maintain two lines, one focused on the half-black pattern, the other on the light green color. Cross one to the other to correct problems as they arise.

In crossing with Snakeskins cross a Snake male with a fine lace pattern to the Green female. The snake pattern may be coarse in the first generation, depending on the genetics of the Snakeskin. The usual advice is to cross back to the Snake line in subsequent generations.

References

See the *IFGA Half-Black Green* entry. A HB Green is basically an IFGA Green with an additional half-black allele and pattern.

See the *IFGA General Information* page for information on the IFGA, its standard and breeding practices.

Categories

Cat: IFGA; Cat: Green

Albino IFGA Red Delta

Luke Roebuck Albino Red Delta

History

The red head guppy may not have a single origin, and mutations for the red head could have occurred independently in Asia, the U.S. and Russia. However, one theory is that the original red head mutation may have occurred in Russia and then made its way around the world undetected. Apparently the first full reds to appear in Europe arrived in pet stores from Moscow.

Description

An IFGA Red Delta guppy is red throughout the body...although it commonly does not have red in its belly.

Genetics

One of the points of difference between American delta reds and European reds derived from red double swords is that American full body reds are said to be autosomal recessive, while the European reds are Y-linked. If it is true that full body reds are autosomal recessive, then this makes them very unusual. Red when it appears as spots on the body are Y-linked. There is heavy selection for red spots on wild guppy males. According to a theory originally proposed by Dr. Larr, and since promulgated by Paul Gorski, there are at least six different red genes, accounting for the variation you see in the color on different red guppies. According to this theory, there is not a single gene making the entire body a single red color. The more red genes involved, the redder the guppy. The fewer red genes the pinker the strain.

References

See the *IFGA General Information* page for information on the IFGA, its standard and breeding practices.

Categories

Cat: Full Red; Cat: Red; Cat: IFGA; Cat: Albino

IFGA Albino

IFGA Albino. Photo: Philip Shaddock

Description

IFGA Albinos are simply guppies with pink eyes, known as RREA (Real Red Eye Albino) in Asia. The mutation is autosomal recessive.

This guppy has a red spot in the front of the body. See the Notes section at the end of the Color Bank for the article "*Red Spots.*"

References

See the *IFGA General Information* page for information on the IFGA, its standard and breeding practices.

Categories

Cat: IFGA; Cat: Albino; Cat: Red Spots

IFGA AOC Pastel

IFGA AOC Pastel. Photo by Philip Shaddock. Taken at an IFGA show.

Other Common Names
Polunas/Piteo Yellow Pastels

Description
This strain is a nice example of the class. Luke Roebuck, the IFGA guppy judge and breeder calls it the All American Strain. It is most likely a Half-Black Pastel with the blond mutation.

This guppy has red spots. See the Notes section at the end of the Color Bank for the article on "*Red Spots*."

Genetics
The strain has the blond mutation, called gold in the U.S. It is autosomal recessive. This strain also appears to have the Half-Black allele.

References
See the *IFGA General Information* page for information on the IFGA, its standard and breeding practices.

Categories
Cat: IFGA; Cat: Red Spots; Cat: Blond; Cat: Half-Black; Cat: White Tail; Cat: Pastel

IFGA Yellow

IFGA Yellow. Photo: Philip Shaddock

Other Names
Micariff

Description
IFGA Yellow guppies have traditionally been a weak class according to the standard.

Genetics
In wild gray guppies the yellow pigment is a color component of the "olive gray" color. The only way to get a yellow guppy is to use a metallic guppy, like the Mikariff, which substitutes light-reflecting iridophores for black color cells. Micariffs have been used as yellow guppies in this IFGA category successively by Mike Khalid.

For the genetics of the strain, see the *Micariff* entry in the Color Bank.

References
See the *IFGA General Information* page for information on the IFGA, its standard and breeding practices.

Categories
Cat: Metal; Cat: IFGA; Cat: Micariff; Cat: Yellow

IFGA Multi

IFGA Multi. Photo: Philip Shaddock. Taken at an IFGA show.

Description

Multi in the IFGA refers to a guppy with three or more colors in the caudal. In this case the multi has red, green and black in the caudal.

Another example of an IFGA multi. Notice the bars in the peduncle. Taken by Philip Shaddock at an IFGA show.

Genetics

Rick Grigsby, an American IFGA breeder, has created multis from crosses between IFGA guppies and his line of Bader Snakeskins. Bader Snakeskins have a "bar" allele creating vertical, elongated patches or bars of color in the peduncle area. Indeed, if you look closely at the peduncle area of the above guppy (the area in front of the tail), you will see the typical vertical pattern of the bar gene. It is possible that the multi guppy in the picture above is simply a common IFGA guppy (IFGA red?) with snakeskin fins (Sst) and the autosomal bar gene.

The genotype for the multi pattern is:

$X^{(Sst)}Y$ bar/bar

Where Sst = snakeskin allele for the fins, bar = the bar allele.

See the Notes for the *Bar and Zebrinus* gene.

What is interesting is that the vertical bar pattern in snakeskins has been banished by the IFGA judging rules (they call such a guppy a "cobra"), but it has snuck back onto the judging bench as a "multi." Of course it should be noted that a multi guppy does not need the snakeskin gene to show three colors in the caudal and does not need the bar gene either.

References

See the *IFGA General Information* page for information on the IFGA, its standard and breeding practices.

Categories

Cat: IFGA; Cat: Bar Gene; Cat: Variegated; Cat: Snakeskin Tail; Cat: Red; Cat: Red Tail; Cat: Variegated

IFGA Bronze

IFGA Bronze. Photo by Philip Shaddock. This guppy won first place in its class at the IFGA 2000 annual.

Description

The IFGA Bronze shows the distinct reticulated pattern of black color cells along the scale edges. Although it is a specific IFGA show class, in fact the phenotype is a mutation called "golden" in the original scientific paper (Goodrich, 1944).

Genetics

The mutation is autosomal recessive, so both the male and female need to be golden in order to produce all golden fry. It is inherited in a typical Mendelian manner. See *Autosomal Recessive* in the Common Genetic Terms section.

The genotype is:

XY g/g

Where g = golden.

References

See the *IFGA General Information* page for information on the IFGA, its standard and breeding practices.

Categories

Cat: Blond; Cat: IFGA

Mosaic Red Fantail

Mosaic Red Fantail. Photo: Philip Shaddock. Taken at an IFGA show!

Description

This particular fin shape is called "Fantail" in Asia, marked by its broad vertical size, relatively short length, and rounded edges. The mosaic pattern and the caudal red color are often found together. For a discussion of red color cells, see the Notes section, *Xanthophores / Erythrophores: Yellow and Red Color Cells*.

Genetics

The variegated pattern (called Mosaic in Asia) has been studied by the Singapore scientist Violet Phang.

> **Genetic Basis of the Variegated Tail Pattern in the Guppy, Poecilia reticulata**
> Gideon Khoo, Tit Meng Lim, Woon-Khiong Chan and Violet P. E. Phang
> ZOOLOGICAL SCIENCE 16: 431–437 (1999)

The variegated allele (Var) is dominant, and according to Phang readily crosses over. It can be X-linked or Y-linked. The fantail gene is usually X-linked. The genotype for this guppy is as follows:

$X^{(Var)(Fa)}Y^{(Rdt)}$

Where Var = Variegated; Fa = fantail; Rdt = red tail.

Categories

Cat: Variegated; Cat: Red Tail; Cat: Mosaic Tail; Cat: Fantail

Variegated Emerald Green Doublesword

Picture taken by Finn Bindeballe at a Danish guppy show.

Other Common Names
Bunt Doublesword or Bunt Doublesword.

Description
The German word "bunt" means multicolored or variegated, an apt description of this doublesword.

Genetics
See the *Vienna Emerald Green* entry for more information on the strain this guppy is likely descended from. This guppy has the *Emerald Green Iridescent* gene. (See the Notes on this gene.)

Fin genetics are detailed in the *Swordtail Fin Shape* in the Notes.

This guppy probably has a snakeskin body gene and red tail gene for the fins.

It appears to have areas of black in the front of the body. See the article *Bandit Markings* in the Notes section.

Reference
See the entry for the IKGH standard.

Categories
Cat: European; Cat: IKGH; Cat: Variegated; Cat: Swordtail; Cat: Doublesword; Cat: EGI; Cat: Snakeskin, Cat: Red Tail; Cat: Vienna Emerald Green; Cat: Bandit Markings

White HB Female

White Half-Black Female. Photo by Philip Shaddock

Description

This is a strain where the focus is on female color, and males are selected that support colorful females.

Genetics

See the Notes section for information on *half-black* color biology and genetics.

Categories

Cat: Half-black; Cat: White Tail; Cat: Female

Red Fin Metal Speartail

Red Fin Pintail. Photo by Finn Bindeballe

Description
This particular strain appears to have platinum gold color in the front of the body and coral red in the half-body area, plus a red tail.

Genetics
Please refer to *Speartail Fin Shape* in the Notes.

The red tail trait is usually due to a Y-linked gene (Rdt).

Metallic traits are commonly inherited autosomal recessive.

Reference
See the entry for the *IKGH Standard* in the Notes section.

Categories
Cat: European; Cat: IKGH; Cat: Red Tail; Cat: Speartail; Cat: Platinum; Cat: EGI; Cat: Coral Red

Albino Pastel Tuxedo

Albino Pastel Tuxedo (Philip Shaddock)

History

The first Half-Black Pastels came from a breeder in Germany, Mr. Gerhard Gellrich. He shipped his new strain to the U.S. sometime around the end of the sixties. At the same time he shipped some to Japan. The modern strains have descended from these originals.

Description

The Japanese version of the Half-Black Pastel tends to be smaller than IFGA or IKGH versions. However the Half-Black pattern is usually darker and richer. The demarcation line between the half-black pattern and the front of the body is also better defined. You find blond and albino genes in many Japanese strains. When Half-Black Pastels are young (2 to 5 months), their fins are yellow. They become pastel as the males approach maturity.

Often a white "saddle" of white leucophores shows just below the dorsal. There are versions of this strain that are basically Half-Black Pastels covered almost completely with white leucophores (sometimes colored yellow because of yellow color cells above the leucophore layer).

Genetics

See the Notes section for information on *half-black* color biology and genetics.

There are other color genes. The albino gene is autosomal recessive.

Categories

Cat: Albino; Cat: White Tail; Cat. White, Cat: Half-Black; Cat: Pastel

Vienna Emerald Green Swordtail

The original version of the Viennese Emerald Green Swordtail. You can see the emerald green color. Photo by Andrew Lim.

Other Common Names

Called the Wiener Smaragd in Europe.

History

This is one of the oldest breeds of guppies, and the foundation of most of today's swordtail strains.

Description

Swordtail guppies have elongated fin rays at the top and at the bottom of their caudals. They have also been bred to have elongated dorsals. The best double swords are often found on this strain. The strain is hardy and can live for two or three years.

The ideal overall color is metallic green. The pattern on the body is best described with the German word "mäanderförmigen," which can be roughly translated as a "meandering form," having a wavy pattern like a ribbon in the breeze or a river wandering over a plain. The best examples should also have a "Peacock Butterfly" (black eye spot with iridescent edge) pattern on the caudal. The front half of the body should have black streaks. The fin coloring can vary from yellow, red to blue hues (often very pastel) with a black seam at the outer edges of the fin. Genuine Vienna Emerald Greens with these colors are now relatively rare. This strain is now found in lower sword or double sword variations.

Genetics

Females of this strain tend to be colorless and are widely used to improve the body shape and fin shape of other swordtails.

This is said to the foundation strain for modern swordtails. Certainly the name of the strain contains a reference to its most important trait: Emerald Green. The pattern includes the black wavy line at the top front,

black spots in the lower part of the front of the body, the trail of red spots on the body, the green iridescent spot at the base of the peduncle and green iridescence on the lower part of the body. The Emerald Green Iridescent pattern is strongly Y-linked, making it a kind of genetic marker, since the trait can only be passed on from father to son.

See the *Emerald Green Iridescent* article in the Notes section at the end of the Color Bank.

For the genetics of the sword, see the Notes section *Swordtail Fin Shape*.

Reference

See the Notes section for the article *IKGH standard*.

Categories

Cat: European; Cat: IKGH; Cat: Red Spots; Cat: Swordtail; Cat: Doublesword; Cat: EGI; Cat: Vienna Emerald Green

Yellow Fin Blue Metal Doublesword

Yellow Fin Blue Metal Doublesword

Other Common Names

Aquamarine Doublesword or Double Sword

Description

At first glance this guppy appears to have the Japan Blue gene. However, the fact that the blue / green iridescent color spreads over the entire body makes this somewhat doubtful. This is more indicative of the action of the Emerald Green Iridescent (EGI) gene. Or perhaps it is a combination of both Japan Blue and EGI genes, co-dominantly expressed.

Genetics

The Green Emerald color is due to the *Emerald Green Iridescent* gene. See the Notes section on this gene.

The double sword tail shape is due to many genes. See the *Swordtail Fin Shape* entry in the Notes for more information about swordtail genetics.

See the Notes entry for the *IKGH standard*.

Categories

Cat: European; Cat: IKGH; Cat: Swordtail; Cat: Doublesword; Cat: EGI; Cat: Yellow Tail; Cat: Japan Blue

Japan Blue

The Classic Japanese Japan Blue. Guppy and photo, Philip Shaddock

History

The Japan Blue comes originally from the wild. The wild form was discovered in a river in the Kanagawa Prefecture around the late 80's. The wild type does not have the large flowing tail of the contemporary version, but it is beautiful in its own right. The Japan Blue was first described in a Japanese fish magazine in 1994.

The fancy Japan Blue in Japan is medium-bodied and commonly available as a veil tail (see the picture above). The dorsal is usually small. The strain matures quickly and has a short life, averaging just over a year. A version with solid blue fins is also popular in Japan. It is said to have led to the Lazuli, another strain in the Color Bank. However this may not be true.

As soon as the wild Japan Blue was discovered, the Japanese began to put its gene in their fish. Yoshiki Tsutsui developed the Topaz (RRE Albino Japan Blue Neon Tuxedo) strain from the Japan Blue.

Description

The Japan Blue is also known as the Aquamarine in Asia.

The Japan Blue has a bright, metallic sky blue body and fins that can be solid, dotted, mosaic, red or a variety of other colors. It is the purity and sky blue quality to the iridophores on the half-body area that gives this strain its special quality.

The spotted fins seen in the picture above probably resulted from a cross with the Japanese Grass guppy.

There are four traits that make Japan Blue unique.

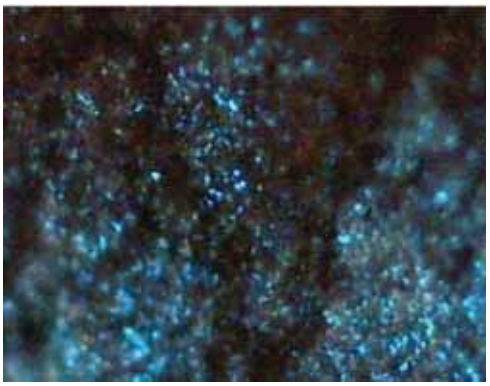
1. First of all it is the heavy density of blue reflective cells, the iridophores in the half-body area. These provide the guppy with its well-known metallic look.
2. The second trait may be related to the first. The Japan Blue seems to have exclusively blue reflective

color cells (iridophores), and no white, silver, or iridescent iridophores, at least in the half-body anterior part of the body.

3. There appears to be black markings in the front of the body. (See the *Bandit Marking* article in Notes.)
4. Finally, there appears to be no pigment color cells in the half-body area, otherwise it would be a "Japan Green."

The red spots and streaks on the anterior of the Japan Blue is typical, and may be considered a fourth trait. Red is usually dominant over blue, and red spots often are linked tightly to the sex-determining region on the Y-chromosome. See the *Red Spots* article in the Notes section at the end of the Guppy Color Bank. The black spot in the front of the body also appears to be typical of Japan Blues.

Genetics



Microscope view 100x of the blue peduncle of the Japan Blue.

Japan Blue and snakeskin cross. Notice the blue background to the snakeskin pattern.

This guppy is fun to cross because of its interesting genetics. A cross-over has created an X-linked version, but the most common location of the Japan Blue gene is the Y-chromosome. It is fairly tightly linked to the sex-determining region on the Y-chromosome, and the trait is passed directly from son to father.

The late Häkan Turesson reported that a cross between a Y-linked Japan Blue and an X-linked snakeskin produces offspring showing both traits. When the fry are young they show a lot of Japan Blue color, but as they get older the Japan Blue is overtaken by the Snakeskin pattern and shows only a tint of blue under the snakeskin pattern.

The cross between an X-linked Japan Blue female and male Galaxy produces a beautiful combination

An interesting cross is the Japan Blue male to a half-black female. The half-black appears metallic.

Albino Japan Blue

A wildtype guppy with Japan Blue. Photo by Karen Koomans

In the picture above left, you can see that the albino version of the Japan Blue loses much of the intensity and saturation of its blue color. The reason is that black color cells (melanophores) at the base layer of the skin act to absorb light passing through the skin. When it is absent, as in the case of the albino Japan Blue, the light is reflected back through the skin, washing out the blue to some extent.

The guppy at the top of this entry is a classic Japanese version of the "Aquamarine" guppy. It is probably the result of a cross between a wild Japan blue and a Grass guppy. The dotted pattern in the fin would suggest this. Since the Japan Blue metallic color only affects the peduncle, the genetics of any particular form of Japan Blue will depend on the presence of the gene for the fins. For example, a Japan Blue with red fins is popular. In the wild form the fins were colorless and short, or with some color. So the genotype for the guppy at the top of this listing is:

$X^{(Gra)}Y^{A}$

Where Gra = grass fins, A = Aquamarine or Japan Blue

Breeders Comment
Philip Shaddock

This particular strain was actually Y-linked for the swordtail gene and X-linked for the Cp (Pigmentierte caudalis) gene. When it was out crossed it lost the Cp gene and the males had poor swordtail fins. Notice that the caudal fin is missing color on its trailing edge. The color in the fin exactly parallels the shape of the trailing edge. For a discussion of the Cp gene, see *Pigmentierte caudalis (X,Y)* in the Notes section at the end of the Guppy Color Bank.

Categories
Cat: Japan Blue; Cat: Metal; Cat: Asian, Cat: Japan; Cat: Grass; Cat: Bandit Markings

Hawaiian Blue Moscow

Bred and photographed by Philip Shaddock

History

This strain has a long history stretching back to Japan and Germany before that. It was named by Luke Roebuck, who got it from a breeder on the U.S. Eastern seaboard, who in turn got it from a breeder in Hawaii. It has spread from there. Philip Shaddock exported it to Italy (Alessandro Cellerino), where it was eventually acquired by the Italian breeder Nico Roselli, returning to Europe.

For a detailed history of the Moscow, see the *Moscow General Information* article in the Notes section.

Description

While the Hawaiian is typical of Blue Moscows, it's particular characteristics are large, thick, flowing fins, sky blue heads, and sometimes blue lips. The strain has a large round dorsal and rounded corners on its caudal. This particular Hawaiian Blue strain has a "pure gold" gene that gives it yellow color at the base of the peduncle, and yellow highlights throughout the body. Bred properly, it has a thick, short body. Properly fed, females are very fertile. It can be a very dark blue, although the black component of the color easily fades under stress.

Genetics

For general comments about Moscow genetics, see the *Moscow General Information* article in the Notes section.

The guppy has genetics typical of Blue Moscows. The exception is the yellow metallic color you see in the guppy in the picture at the top of this entry. This yellow metallic color showed up in three different out crosses. See the Silverado, Onyx Black Moscow, and Stoerzbach Moscow entries.

Difficult to see in the photograph is a ghost of a red spot. When this strain has the golden mutation (called Bronze in the U.S., tiger in Asia and Gold in Europe) the presence of red spots is revealed in all its glory. See the Notes section about *Red Spots*.

Other strains of Moscows have been shown to have these red spots. Since red spots are tightly Y-linked, it may be the case that the gene is part of the Moscow supergene.

Breeders Comments
Philip Shaddock

The Moscow is a particularly good guppy to use in crosses. About two-thirds of the strains in my fish room trace back to Hawaiian Blue Moscows. In crossing to Magentas, Stoerzbach Metals, American Half-Black greens with the Onyx allele and Pink guppies, I have been able to create an incredible variety of strains while keeping them cross-compatible.

Categories
Cat: Blue; Cat: Moscow; Cat: Red Spots

Green Snakeskin

Green Snakeskin bred by James Heller

Other Common Names
Green Cobra (Cobra is an Asian name for snakeskin)

History
Jim Heller imported this particular strain from Europe into the U.S.A. in the 1990s.

Description
The green snakeskin has a coarse snakeskin pattern over 90% or more of it's body.

Genetics
The snakeskin gene is sex-linked and easily crosses over from the X to Y chromosome. According to a study by the scientist Dr. Phang, the snakeskin fins are due to a separate gene. So the genotype for this guppy would be:

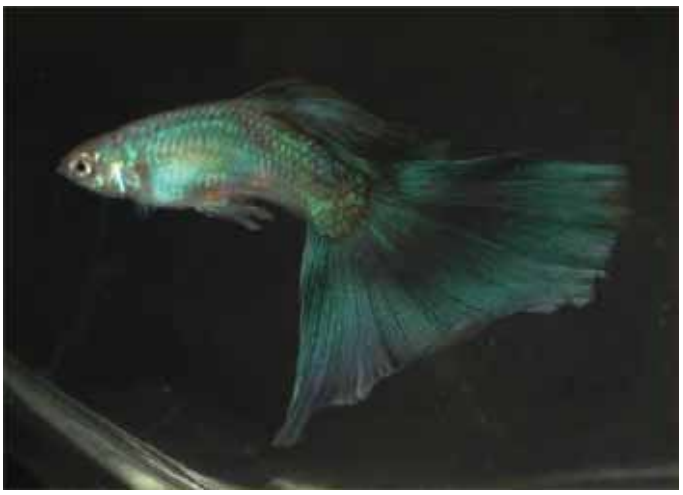
$XY^{(Ssb)(Sst)}$

Where Ssb = snakeskin body, Sst = snakeskin fins

See the *General Snakeskin Information* article in the Notes section.

Categories
Cat: Green; Cat: Snakeskin

Green Moscow



Green Moscow competing at an IFGA show (Philip Shaddock photo)

History
See the *Moscow General Information* article in the Notes section.

Description
This strain of Moscows is simply a Blue Moscow with an increased number of yellow xanthophore color cells. This color is found in all Blue Moscow drops, at least to some degree. Crossing with IFGA Greens will bias the color to green.

Genetics
See the *Moscow General Information* article in the Notes section.

For the red spots on the peduncle, the Red Spots article in the Notes section.

See the article in the notes on yellow and green color cells, *Xanthophores and Erythrophores*.

Categories
Cat: Moscow; Cat: Green

Glass Guppy

Glass guppy. Francis Yap, Singapore

Description

This guppy has a complete absence of black color cells in the body, while the eyes are dark black. It is also missing yellow and red color cells. The only color cells it is showing in the body and fins are iridophores. It apparently reflects white and blue light from these iridophores and never shows any other color, even under different lighting, according to the breeder, Francis Yap.

Genetics

Unlike a Super White (also called a Triple Recessive), this guppy is not an albino. So the fact it has no black color at all, except in the eyes, makes it very unusual for a guppy. It cannot be a form of albinism or even a partial albinism because it has jet black eyes. It is possible this guppy is a combination of mutations, including the blond, and several different types of yellow and red mutations.

Breeders Comments

Francis Yap

Mr. Yap has said that the strain came out of guppy round tails, not an Endler cross, and suspects they may have had the "blau" mutation. However he apparently is not sure of the genetics. By "blau" mutation he is referring to what is also known as the Asian Blau mutation where the red and yellow color cells fail to develop.

Categories

Cat: Triple Mutant; Cat: Miscellaneous

German Yellow Tuxedo

German Yellow Tuxedo. Photo sent to Philip Shaddock by Eddie Lee

History

In 1969 the Japanese imported the Half-Black Yellow from Germany and developed a number of strains out of this stock, including strains that are still called Half-Black Yellow, even though they do not have any yellow on them. For example the Japanese Half-Black Pastels often go by this name. The Japanese term for the half-black pattern is "tuxedo." They are called this because half-black guppies look like they are wearing tuxedos! The German Yellow Tuxedo has been a mainstay of Japanese strains.

Description

Despite its white fins in the above picture it is called "German Yellow Tuxedos" in Asia. It's basically a half-black guppy (tuxedo) with white or yellow fins. The white fins have a lot of white leucophores and some yellow color cells, the yellow have a lot more yellow color cells.

Genetics

The Japanese love of crossing strains is exemplified in the many Japanese strains that have arisen out of the original German Half-Black Yellow stock. For example, the original strain was crossed to Half-Black Reds. The "Flamingo" guppy is similar to the North American Half-Black Red. The Neon Tuxedo has silver hues on the back and has a delta caudal. The Japanese author and breeder Iwasaki speculates that it is a result of crossing a Red Tuxedo with a Singapore Neon Blue guppy. Iwasaki: "Crossing a German Yellow Tuxedo with a Tiger Bottom Sword produces wonderful silver-backed Red Tail Tuxedos, but the fish are weak, and in the F2 generation so weak as to mostly die out." Iwasaki's reference is to strains that predate 1989.

The *half-black* allele in this strain is discussed in the Notes section.

Categories

Cat: Asian; Cat: Japan; Cat: Half-Black; White; Yellow

Galaxy

Galaxy (Luke Roebuck)

History

The Galaxy was an original creation of Yoshiki Tsutsui. He developed it in the 1990s.

Description

The unusual "bandit" markings in the fore part of the body and black markings on the rest of the body are characteristic of this strain and show the snakeskin and metal genes interacting.

Medusa roundtail guppy. Guppy and photo by Karen Koomans

Compare the bandit markings on the Galaxy to the blue area at the front of the Santa Maria guppy. (See the *Santa Maria* entry in the Color Bank.)

In North America, the caudal colors range from yellow and black, to olive gray with yellow spots. The Japanese varieties have a wider range of colors and patterns. The Blue Galaxies have been crossed with Japanese Blue Glass guppies, sometimes called a Blue Variegated Cobra. This version of the strain also yields yellow and white versions. An albino version is also part of this version of the strain.

Tsutsui told us that he called the unusual guppy "Galaxy" because of

the "very good color."

Another Japanese breeder developed a strain similar to the Galaxy, called the Medusa (see previous page). The Medusa is found with "calico" like colors in its caudal.

Genetics

The Galaxy is a result of a cross between a Snakeskin and a Platinum guppy. Tsutsui used this combination to create the strain. He told Philip Shaddock it was a result of a crossover event. The platinum gene is commonly found on the Y-chromosome, although it crosses over relatively easily. The same is the case for the snakeskin allele. So it really does not matter if Tsutsui started from a male Snakeskin to a female Platinum cross or both. Tsutsui said that he crossed Snakeskins and Platinums many times during a two year period (from 1992 to 1994) until he found one male with both the Platinum and Snakeskin gene on the Y-chromosome.

The snakeskin is often called the cobra in Japan and you will also see its gene designated as Fil (the European term for snakeskin is Filigran). So the genetics of a Galaxy is often rendered in Japanese sites as:

$XY^{P(Fil)}$

Where P = dominant Platinum allele, Fil = dominant snakeskin allele.

However, this is too simple! Just as the snakeskin pattern covering the whole body and fins of a snakeskin is actually due to two genes, one for the body (Sst) and the other for the fins (Ssb), the more accurate genotype is:

$XY^{(Ssb)(Sst)P}$

Where Ssb = snakeskin body, and Sst = snakeskin fins

The fact that there are separate genes for the body and the fins is confirmed by the existence of Galaxy guppies with solid red fins and other colors and patterns. So the genotype for a red fin Galaxy is:

$X^{(Rdt)}Y^{(Ssb)(Sst)P}$

Where Rdt is red tail.

This combination will produce a guppy with red fins and black spots, the result of the fact the Snakeskin fin pattern and the Red Tail fin genes are both expressed. In order to get a Galaxy with solid red fins, the Snakeskin fin allele should not be present.

Since the Galaxy is basically a Snakeskin with a Platinum allele on the same chromosome (Y), we can assume that the different genes and alleles affecting the Snakeskin pattern also come into play. For example lace snakeskins can be expected to produce Galaxies with a much finer and tighter pattern than coarse snakeskins. See the Snakeskin General Information entry. Tsutsui told Philip Shaddock that the form of the snakeskin he used was lace. (Lace however may just be the snakeskin allele homozygous.)

The Platinum allele produces an abundance of iridophores (metal color cells). The snakeskin allele produces alternating areas of black color cells (melanophores). So the theory is that the overabundance of iridophores

overwhelms the Snakeskin pattern. In fact, if you examine a Galaxy, it looks like it has a lot more iridophores than a Snakeskin.

The Blue Galaxy is a variation that is a red Galaxy with the Asian Blau mutation in the heterozygous state. Typical of many Japanese fish, it has fairly complex genetics and a knowledge of its genetic make-up is essential to keeping it true to its heritage. See the *Asian Blau Mutation* in the Notes section at the end of the Guppy Color Bank.

Galaxy Variations

White Galaxy by Uwe Bergmann

The White Galaxy, shown at left, is found in the same strain as the Red and its blau version.

The Medusa is a closely related strain. It has very similar genetics, but may have additional color genes for the fins.

The Japanese have created some excellent hybrids using the Galaxy. A particularly beautiful form is a Galaxy that has been crossed with an X-linked Japan Blue.

The Blue Galaxies have another influence: Japanese Blue Grass guppies. The cross is sometimes called a Blue Variegated Cobra.

This strain also yields yellow and white versions.

Breeders Comments

Luke Roebuck

The White Galaxy I believe is a result of the polygenetic inheritance and interactions of the blau (rr) and gold (gg) (bronze in the U.S., tiger in Asia) genes in the new galaxy strains. Blue and white galaxy is recessive to normal yellow/gold and multicolored galaxy fins. There are rare albino versions which do not originate from one albino variety but from different sources.

My version originated from some fish given to me by Edgar Chiasson in Milwaukee 1998. This version is quite unique and probably the best Albino galaxy version in the world today. A green female was used to make the strain in the earliest of out crosses.

Like with the Gray version, the Albino versions are cross compatible with the Albino Versions of the Blue Glass strains.

Uwe Bergmann

Uwe points to the black spots seen in the front of the body of the Blue Galaxy. These spots become dense, amorphous areas of black in the front of the Galaxy's body. They are obviously ectopic melanophores.

Categories

Cat: Snakeskin; Cat: Galaxy; Cat: Platinum; Cat: Bandit Markings

Full Red

European Full Red guppy. A fine example photographed at a Danish guppy show by Finn Bindeballe.

History

The Full Red guppy may not have a single origin, and mutations for the red head could have occurred independently in Asia, the U.S. and Russia. However, one theory is that the original red head mutation may have occurred in Russia and then made its way around the world undetected. Apparently the first full reds to appear in Europe arrived in pet stores from Moscow. There is some evidence that the red head Full Red descended from Moscows.

Description

A Full Red guppy is red throughout its body, including the belly. The Coral Red Double Sword guppies with red heads are also full red, but they are treated as a separate topic and classified as metallic red guppies. Crossing a Coral Red Double sword with a red delta female produces a full red guppy.

For a discussion of red color cells, see the Notes section, *Xanthophores / Erythrophores: Yellow and Red Color Cells*.

Genetics

One of the points of difference between American Red Deltas and European reds derived from Coral Red doubleswords is that American full body reds are said to be autosomal recessive, while the European reds are Y-linked. See the extensive discussion of Full Red color and genetics in the *Full Red* article in the Notes section.

Breeders Comments

Hans-Peter Neuse, European Full Reds

Hans-Peter Neuse gives the following advice about breeding his European Full Red line: "The color is dominant on the Y-chromosome, but the color is very, very difficult, when you make crosses. You will loose much of the intensive red. The females are mid-sized, the best have a red backside, with a lit bit of blue in the caudal. I never make crosses between grey reds (because of black spots on the caudal) and my reds. The best way to improve your strain is to make crosses with normal blond red females. You will get some very big ones! Then you have to select for improving color. I know, it's a long way to go to get satisfying good results, but it's worth it!" Hans Peter Neuse on the GKR forum says: "For all the years I´ve been breeding Full Reds not one yellow version appeared in my lines. Maybe one reason could be, I carefully avoid using females with yellow in the finnage for breeding! I prefer females with blueish fins, like this one:"

Edgar Chiasson, American Full Reds

Edgar Chiasson is an American breeder. A Chiasson Full Red guppy is red throughout the body, including red in its belly. Chiasson developed his full reds from Dr. Jim Alderson stock that were showing grey on the stomach area, not the normal white. He worked the red into the stomach area. He has reported that the full reds do not cross very well with normal reds. The red in the stomach area is apparently lost. The "six red genes" theory is disputed by Ed Chiasson since his test crosses show that the color is not multigenic and additive. Ed also does not believe red is a dominant color. "Every time I have out crossed to a non-red you get a blending, muddy or blotching of color. I have out crossed both ways to H/B Pastel. In crossing to yellow you get orange streaks, always some evidence of that color, much like a Micariff in its red/yellow version. I out crossed to Pingus. You get a pink-like red but looking more like a red, not a Pingu. My observations have been that the color is not dominant but rather is co-dominant with other colors." Ed has also said that his inbred reds occasionally throw yellow guppies.

Categories

Cat: Red; Cat: Full Red

Leucophore White

Leucophore White (Philip Shaddock)

Other Common Names
Japanese HB Pastel White

History
This particular strain originated from the Czech Republic where the German fish broker, Omer Guelmez, farmed them out. However, the strain originally came from Japan.

Description
White color in guppies can be the result of two different types of color cells, iridophores and leucophores. The guppy in the above picture has mostly leucophores on the sides of the body. The green you see near the caudal is due to the presence of blue iridophores in that area.

Unlike Platinum guppies, you do not see a metallic sheen on this guppy. Compare this guppy to a Micariff, which does have a metallic white sheen.

Categories
Cat: Asian; Cat: Metal; Cat: White; Cat: Leucophore; Cat: White Tail

Platinum Speartail

Platinum Speartail. Picture by Flemming Stræde

History

This is a very old strain. Original developer unknown. However the Schimmelpfennig Metal Sword was a mutation out of the Vienna Emerald Green Swordtail, and since this strain looks like the Schimmelpfennig Metal strain, that is a likely origin.

Description

The picture shows a blond version of the speartail.

Genetics

For the speartail genetics, see *Speartail Fin Shape* in the Notes.

Breeders Comments

Flemming Stræde

Guppy and Picture by Flemming Stræde

"I got it from Matthias Manken in Germany a couple of years ago. It is a very old strain, living proof that inbreeding isn't a problem in guppy breeding.

From the start we had some troubles, with males being infertile due to extended gonopodiums. That problem we succeeded breeding out of the strain. To be honest females are an ugly looking guppy, but it seems to have no effect on the males.

The strain is pure breeding, but it doesn't produce a lot of fry, twenty fry per batch is normal. Heavy feeding with live food, or any kind of high protein food will bring up num-

bers.

The strain has in the past year done very well in European shows, and several times it has reached points in the eighties. As far as I know, only three European breeders keep the strain, so its not that common.

I have only taken a few good pictures of this strain, and to be honest not two with the fish showing the same color. It sort of changes with the background, plants or what kind of mood it's in. It's not a problem though. Seems like all fish in a tank pick up on the same colors, like a common chameleon characteristic."

Reference
See the entry for the IKGH standard.

Categories
Cat: European; Cat: IKGH; Cat: Platinum; Cat: Speartail

Santa Maria

Santa Maria with bar gene.

Without bar gene. Pictures: Yours Young

Description

The Santa Maria strain is visually defined as a snakeskin with the navy or blue area of color in the front of the body. The distinctive patch of color in the front of the body is very similar to the so-called "bandit markings" found on the Galaxy strain. (See the *Bandit Markings* article in the Notes Section.) Is it a common feature of a number of strains. It is found also on some, but not all, snakeskin lines. Oddly, it is also reminiscent of the blue or black patch of ectopic melanophores found in the front of the body of the Moscow. This is possibly a Y-linked gene and may be indicative of a common heritage among these guppies.

The strain comes in a number of varieties, but the most popular is a grey body with dark navy lines and a red caudal. It is often crossed with cobra (snakeskin) guppies and guppies with mosaic caudals.

The vertical "cobra stripes" in the peduncle of the guppy above are due to the bar gene.

The Santa Maria guppy has rarely, if ever, been imported into North America and is scarce in Europe. Even in Japan it is maintained mostly by collectors and has never been particularly popular.

The Japanese Breeder Fukagawa is the prominent breeder of this strain since the 1990s. He has produced many variations; such has the Hi-Fin Santa Maria Bottom Sword, RREA Redtail and so on.

Genetics

According to the late Yoshiki Tsutsui, the Santa Maria belongs to both the Störzbach Metal and Platinum family of guppies. (The platinum family in Japan is descended from Schimmelpfennig Swords. It is a metal gene.)

The Santa Maria gene is Y-linked.

The Bar gene is discussed in the article *Bar and Zebrinus Genes* in the Notes section.

Tsutsui shows the strain as coming out of a Platinum Sword (Guppy Base Book Vol.1, p. 133), probably the Schimmelpfennig Sword imported from Germany by Tsutsui. So its genetics combine the recessive Störzbach metal and Platinum genes.

Tsutsui shows the genetics as X $Y^{(Sa)}$ s/s. Presumably the s/s gene is a reference to the autosomal recessive Störzbach metal gene. In any event the Störzbach autosomal recessive genes appear to be at the root of this guppy, with the Santa Maria gene (derived from the Platinum gene) on the Y-chromosome.

Yours Young of Taiwan

The strain shows evidence of snakeskin genes as well, though Tsutsui does not mention this.

A peculiarity of this strain is that the blue stripe identifying this strain turns to red when an albino version of this strain is created (picture on left). It is a good question why the absence of melanin would turn an area blue on a grey guppy to red on an albino guppy. We do know that pigment color cells influence what type of iridophores develop in association with them.

Categories

Cat: Bar Gene; Cat: Platinum; Cat: Stoerzbach; Cat: Snakeskin; Cat: Asian; Cat: Japan; Cat: Albino; Cat: Santa Maria; Cat: Bandit Markings

Micariff

Micariff. Picture by Philip Shaddock

Other Common Names

Sunset Guppy, Yellow Tang, Tequila Sunrise

History

According to the American breeder Mike Khalid, who originally came from the country where the Micariff was developed, Sri Lanka, and who personally knew the designers of the strain, the name "Micariff" is a combination of the names of the two individuals who developed it: Michael Cole and Denis Ariff. Although you often see the name spelled Mikarif, it's correct spelling is Micariff. The Micariff is sometimes known as the "Yellow Tang" guppy, a name given them by Frank Orteca in 1995. In the U.S. it may be known as a "German Sunset" or simply Sunset.

Description

A Micariff is usually a blond guppy with a yellow metallic body. The "German Sunset" version usually applies to the pet store version that has a grey body with red and yellow fins. The strain shown above appears to have a red streak. See the *Red Spots* article in the Notes section at the end of the Color Bank.

The "German Sunset" Pet Store Version

The Micariff began life as a commercial farm-raised guppy, and variations of it often show up in stores. The store-bought version is selectively bred for a huge body and a fan tail, with the dorsal not well developed, like most farmed guppies. This has somewhat sullied its reputation among fancy guppy breeders, but its popular metallic yellow look has given it a home in some top breeders' tanks.

The Micariff is a long-lived strain, are large-bodied and usually hardy and fertile. One of the distinctive features of

the Micariff is thick fin rays. They usually hold their caudals wide open.

Genetics

German breeders believe the Micariff is a combination of a homozygous autosomal recessive gene Stoerzbach metal (ss) in combination with a homozygous snakeskin gene:

Males - $X^{(Ssb)}Y^{(Ssb)}$ s/s

Females - $X^{(Ssb)}X^{(Ssb)}$ s/s

In crossing with other strains, the first generation usually yields snakeskins, meaning the F1 is heterozygous for the snakeskin gene. Only those individuals in the F2 generation that are homozygous for the snakeskin and Stoerzbach metal genes show the characteristic metallic phenotype.

Apparently many Japanese breeders do not consider the Micariff guppy to have a gene unique to the strain, but rather a gene found in a number of strains. The Micariff gene is the "solid" (ss) gene found on many Japanese strains. It is autosomal. The Japanese "solid" gene is not what the name implies, a monochromatic guppy. Rather the English word "solid" transcribes to "shining" for Japanese breeders.

A visitor on the Guppy Designer forum said that the Japanese breeder Masaharu Shindo used the Micariff to create the Japanese Full Gold guppy. Apparently the El Dorado and King Cobra or snakeskin strains make up its background. The German Gold guppy comes from Japan and is possibly related to the Japanese Full Gold, which would bring us full circle. That is, the Stoerzbach guppies imported into Japan make their way back as "German Gold."

The author of the Aqua-Farm Japan book calls the Micariff gene the "material" gene (mm). However Bruce (Hsueh Tseng-Biao) from Taiwan tells us that the original word was probably "metallic." In transliteration from English to Japanese, and then to Chinese, metallic became material. The author of the Aqua-Farm book says it is a recessive autosomal gene that has the peculiarity of showing metallic color on the male but not the female. The author asserts that the Japanese Full Gold strain has the same metallic gene as the Micariff.

The Micariff has been used to create Yellow strains or add yellow to such strains as the Blond Moscow. Luke Roebuck has said that the IFGA gold (gg) (blond in Europe, gold in Asia) HB Yellow makes a suitable cross with this strain.

Breeders Comments

Mike Khalid

Mike Khalid has bred Micariff males to blond (b/b) (U.S. gold) red females. This produces 100% yellow guppies! The question arises: is it necessary for the yellow to be dominant over the red to produce the metallic yellow phenotype of the Micariff? See the *IFGA Yellow* entry.

The Full Gold guppy is believed by some to be the result of a cross to the Micariff.

Categories

Cat: Asian; Cat: Snakeskin; Cat: Metal; Cat: Stoerzbach; Cat: Red Spots; Cat: Blond; Cat: Micariff

Green Platinum Pink White

Platinum green pink from the Thailand exporter X-B-R-E-E-D. Used with permission from Uthen Chaichot.

Description

This guppy shows its Pink White heritage in the white base of its peduncle and in a small white area at the base of the caudal fin. However the dominant phenotype is a green platinum body. If you look closely at the base of the female's peduncle, you will see a "pink white" area. The red caudal indicates a red tail gene is part of this strain's genetic makeup.

Genetics

Philip Shaddock crossed females of this strain with Hawaiian Blue Moscows males and got Blue Moscows with light blue (white blue) fins and the pink white patch in the peduncle. (See the *Pink White Moscow* entry.) This was in the F1 generation. The females showed white at the base of their peduncle as well. Since the females are composed of one X-linked allele from the Moscow father and one X-linked allele from the Pink White mother, the conclusion must be that the Pink White allele is dominant. The fact that the males or females did not have red in their fins, indicates that this strain had a Y-linked red tail allele (Rdt).

This strain is very likely a Y-linked platinum strain with the red tail allele crossed with a pink white strain. The genotype therefore is:

$X^{(Pw)}Y^{P\ (Rdt)}$

Where P = Platinum, Rdt = Red Tail, Pw = pink white

Categories

Cat: Pink White; Cat: Red Tail; Cat: Platinum; Cat: Green

Schimmelpfennig Platinum Sword

Photo by Philip Shaddock

Other Common Names

Schimmelpfennig Metal was the original German name. Sometimes called Schimmelpfennig Sword. Platinum Sword is another obvious choice.

History

The Schimmelpfennig Sword was discovered and developed by Horst Schimmelpfennig, a guppy breeder in Berlin. It is a mutation out of the Viennese Emerald Green Swordtail strain. (According to one account told on Guppy Club Singapore forum by Claus Osche, the strain originated from the Coral Red strain.) This strain is in turn is the foundation for many popular metallic delta strains found in Europe and Japan. The Japanese developed many of their "platinum" strains from imported Schimmelpfennig Swords.

Description

The Schimmelpfennig Sword is usually a bright, shiny yellow with some green and bluish colors as well. The strain is said to be very difficult to maintain in good quality. The double swords tend to develop into ragged lyre tail shapes. The swords are also said to be too narrow, tending toward parallel growth. They can have different lengths, and a new fin extension can develop between them. The dorsal tends to be small. A lack of match between the dorsal and caudal is not an issue in European standards.

Genetics

The strain has the platinum gene, which is usually Y-linked (XY^P). However it readily crosses over.

The genotype is:

$XY^{P\ (Ds)}$

Where P = Platinum, Ds = doublesword

As a Y-linked metal gene, the Schimmelpfennig Sword may have been described much earlier than that found by Schimmelpfennig. It is possible that the first "platinum" guppy was actually described by Winge in 1927 in his THE LOCATION OF EIGHTEEN GENES IN LEBISTES RETICULATUS (Journal of Genetics, 18,1, page 21) paper. He describes the Cinnamomeus Y-linked strain as "a peculiar metallic sheen, of a warm brownish yellow, on the side of the body; most conspicuous in direct light."

The Schimmelpfennig Sword crosses well with the Viennese Emerald Green because of the close kinship between them. Crossing with Coral Red DS females produces a version with deep yellow colors.

See the *Full Platinum* entry for a delta strain with a similar platinum metal phenotype. It is not clear if the Full Platinum has the same platinum gene as the Platinum sword. Notice that the Full Platinum has a white platinum base with a yellow overlay. The Platinum Sword has a more mottled yellow and green distribution of the platinum phenotype.

For the swordtail shape, see the Notes section on the *Swordtail Fin Shape*.

Categories

Cat: European; Cat: Platinum; Cat: Doublesword; Cat: Swordtail; Cat: Metal

Full Gold

Full Gold by Philip Shaddock

History

This is a Japanese guppy. Tomoko Young points (in private emails with Philip Shaddock) to Tsutsui's Guppy Base Vol. 1 (pp. 80-81) for some clarification of the Japanese term Full Gold. Here is a paraphrase of what Tomoko wrote:

> "The original Full Gold was developed by the famous Japanese breeder Masaharu Shindoh, now passed away. He crossed El Dorado x Yellow Grass first, and then crossed with the Japanese King Cobra. Now there are several different versions of Full Gold developed using different strains around the world. Some of the Full Gold strains were exported to Europe. Another strain that came out of these crosses was the Japanese Medusa."

"Cobra" is an Asian term for snakeskin. See the entry for the Japanese *Grass* guppy. The term "grass" refers to the pattern in the tail. See the *Grass* entry. See the *El Dorado* entry.

Description

Full golds are solidly colored yellow metallic guppies. The picture on the following page shows a strain that Luke Roebuck and others call the "Full Gold."

The Luke Roebuck "Full Gold" appears to very similar to the Full Platinum. This appears to be a white metallic guppy with a yellow overcast. (Also compare the guppy to the Micariff white metallic guppy.)

The guppy at the top of this entry looks quite different from the Full Platinum. In fact an old defunct strain called Czech, threw both phenotypes, suggesting that the Full Platinum and Full Gold are mutually exclusive. The Full Gold shows a thin layer of highly metallic gold against a wild grey background. The Full Platinum shows a thick white metallic background with an overlay of yellow color (xanthophores above

iridophores).

Luke Roebuck "Full Gold"

Philip Shaddock "Full Platinum"

Genetics

The Japanese usually indicate that the Full Gold guppy has what they call the "solid" gene, more recently described as the Stoerzbach gene (s/s).

Some clarification comes from the famous Japanese breeder Hoshiki Tsutsui. In his genealogy of the various platinum and metal combinations, he distinguishes the Full Gold as not having the Platinum gene (XY s/s), while the El Dorado does (XY^P s/s). Note that he believed that the platinum gene originated from the Platinum Sword. Another member of this family of metal guppies is the Santa Maria.

The Stoerzbach gene is usually described as having a bluish or greenish color. The Full Gold is very yellow with little or no blue or green overcast. This suggests that another metallic gene may be involved. Further research is required on this strain.

Some people believe the Full Gold is a result of a cross with a Micariff.

Categories

Cat: Asian; Cat: Japan; Cat: Platinum; Cat: Yellow; Cat: Gold; Cat: White Tail

Flamenco Dancer

Flamenco Dancer (Franz Peter Schaffarth)

Other Common Names
Magenta Moscow

History
The guppy in the photo above was acquired by Franz Peter Schaffarth from European stock.

Description
The Flamenco Dancer is a name given to the gene combination: Magenta + Moscow. The Flamenco Dancer has a blue to purple metallic body and red mottled fins. The strain has poor shaped fins. The poor fin shape must be due to the magenta allele's color interaction in the fins.

Genetics
The key genes in this strain are the magenta genes and Moscow genes. Other genes may modify the specific appearance of this strain.

See the *Magenta* article in the Notes section for the Magenta genetics.

Categories
Cat: Magenta; Cat: Moscow; Cat: Blue

Erfurt Wild Guppy

Erfurt Wild guppy group. Dimitri Farla.

History

This guppy was released in the heated waters surrounding an energy site in Erfurt, Germany. They have lived there since about 1975. Like many introduced guppies, these fish have reverted to looking like a wild guppy.

Description

There is some variation between males. Some males show small topswords or more green in the body than the fish shown on the pictures. All females are wildtype females meaning they are a nondescript grey. The males have slender bodies and almost all males show a black spot just above their gonopodium.

Genetics

Notice the red and black spots on the body. This is a common feature of wild guppies. See *Red Spots* in the Notes section at the end of the Color Bank.

Categories

Cat: Wild; Cat: Red Spots

El Dorado

El Dorado bred by Luke Roebuck

History

According Iwasaki in Aqua Life magazine, in 1990 Hiroshi Sugino crossed a German Schimmelpfennig (Platinum) Lyretail and an Old Fashion guppy. Some of the F1 showed a triangle delta tail. Then Gen Hideshima used the F1 to cross to Japanese Mosaic. This is how the original El Dorado was born. Luke Roebuck has said that the name El Dorado was given to the strain by Japanese breeders, who took the name from the ancient "Lost City of Gold" known as "El Dorado." Luke: "I think that the original strain was a deep platinum gold and looked like metallic gold. The original El Dorado is a veil tail shape because it comes from the Schimmelpfennig strain which has that shape. This veil shape is deeply linked in some Japanese Full Gold stock."

Apparently the original El Dorado strain had a real gold body without the green and blue seen on Stoerzbach guppies. It had a yellow-orange to red tail including a black dot in the caudal. They were small with a narrow caudal spread (veiltail).

Description

Albino version of the El Dorado. Luke Roebuck

Genetics

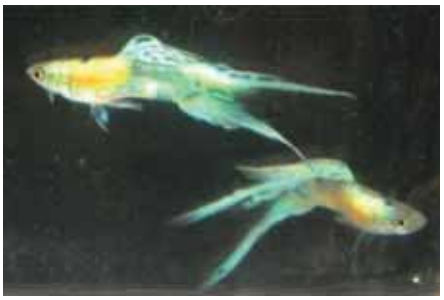
The account of the El Dorado's origins by Iwasaki is interesting because an Old Fashion guppy is basically a Viennese Emerald Green delta tail and the Schimmelpfenning Platinum Lyretail is a mutation of the Viennese Emerald Green.

What also makes this guppy interesting is that it combines an autosomal recessive metal gene with a Y-linked metal gene. Tsutsui describes the metal gene as the "solid" or Stoerzbach gene. He calls

the Y-linked gene "platinum."

Yoshiki Tsutsui's family genealogy of metal guppies shows the El Dorado descended from a Schimmelpfennig (Platinum) Sword that landed in Japan in 1990. It belongs to a group that includes the Santa Maria and Galaxy. According to Tsutsui, the Full Gold strain also has the recessive Stoerzbach (s/s) autosomal genes, but no platinum gene on the Y-chromosome. So the Full Gold and El Dorado appear to differ in that the Full Gold does not have the platinum gene. Another member of the metal family is the Santa Maria.

If you compare the El Dorado to the Schimmelpfennig Platinum Sword, you will see some cursory evidence for the descent of the El Dorado from the German import.



Schimmelpfennig Platinum Sword

Unlike the Full Platinum, the Schimmelpfennig Platinum Sword has a more mottled platinum metal phenotype.

So the genetics are as follows:

- El Dorado: XY^P s/s
- Full Gold: s/s

Where P = platinum; s = Stoerzbach metal

See the *Full Gold* entry.

See the *Stoerzbach Metal* entry for a discussion of the Stoerzbach metal gene.

Categories
Cat: Asian; Cat: Japan; Cat: Metal; Cat: Stoerzbach; Cat: Platinum; Cat: El Dorado

Albino Blau Platinum

Guppy photo by Luke Roebuck.

Description

This strain has a shiny, metallic appearance with a blue cast. It's pink eyes are due to the albino gene.

Genetics

The genetic makeup of this guppy is:

X $Y^{(Rd)(P)}$ Nb/nb a/a

Where Rd = Y-linked red, P = platinum, nb = Asian Blau, a = albino

The blue metallic color is due to the Nb/nb combination of alleles. See the *Asian Blau Mutation* entry in the Common Genetic Terms section of the Genetics Appendixes on the nature of this mutation and how to breed it. The example used there is the Blue Galaxy, but the principles remain the same. For breeding the albino trait, see the *autosomal recessive* entry in the Common Terms section. See the *Platinum* entry in the Notes section for additional information on the platinum mutation.

Breeders Comments

Luke Roebuck

It is known as Platinum but with a new twist- Blue (blau) Platinum. It is the result of a cross between the golden Platinum and the Japan blau "cheat". The colors are chameleon like platinum gold in the body and blue-gold in the tail. When settled down it looks sky blue in the fins! These are the young F1 siblings from the WGC auction in Czech Republic.

Categories

Cat: Asian; Cat: Japan; Cat: Platinum; Cat: Metal; Cat: Blue; Cat: Asian Blau; Cat: Red; Cat: Albino

Blond Red Tail Speartail


Photos and Fish: Franz-Peter Schaffarth

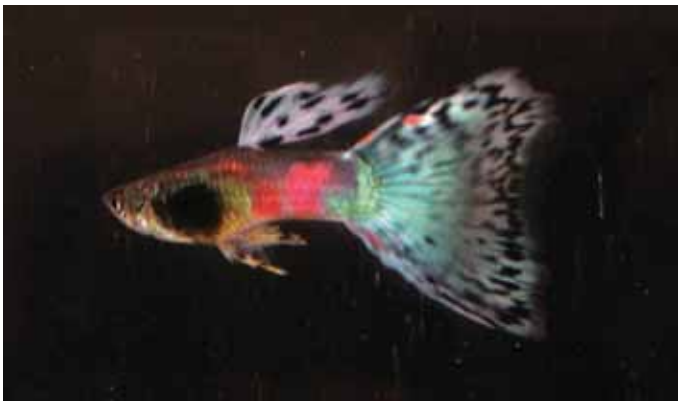
History
See the *Speartail Fin Shape* article in the Notes section.

Description
Both males and females show the speartail phenotype. Unfortunately the males often have an extended gonopodium, making them infertile.

Genetics
See the *Speartail Fin Shape* article in the Notes section.

Categories
Cat: European; Cat: IKGH; Cat: Blond; Cat: Speartail; Cat: Red Tail

Golden Moscow



Golden Moscow by Philip Shaddock

Other Common Names
Tiger Moscow (Asia), Gold Moscow (Europe)

Description
This is the golden version (bronze in the U.S., tiger in Asia, gold in Europe) of the Moscow. Typical of the Blue Moscow version of the strain are the red spots on the peduncle and the spotted fins. The gray version of this particular strain have solid color fins. The females usually have a pronounced reticulated pattern.

Genetics
For general comments about Moscow genetics, see the *Moscow General Information* article in Notes.

The Golden Moscow is a Moscow homozygous for the golden (gg) (U.S. bronze, Europe gold, Asia tiger) gene.

The golden gene is often found in strains where the dark background color is enhanced. Presumably the heterozygous golden guppy produces additional black color cells at the edges of scales, making the guppy blacker.

The golden mutation is an allele of the wild grey color and is recessive to it (gg). Mating two guppies heterozygous for the golden allele produces the normal Mendelian ratio 3:1.

The gene is carried by many Moscow strains, and appears to have been present in the Blue Moscow that originated out of Germany. (Based on an account provided in Yoshiki Tsutsui's Guppy Base Book Vol. 1).

Categories
Cat: Moscow; Cat: Golden; Cat: Red Spots

Blond Moscow

Luke Roebuck's Blond Moscow

Tomoko Young Blond Moscow

Other Common Names

Gold Moscow (the blond mutation is called Gold in the U.S. and Asia)

Description

Both the Moscows on this page are blond (IFGA and Asia gold) mutation guppies. This means their black pigment is not fully expressed because of the blond (bb) mutation. The gray version of this strain is a Blue Moscow. This Blond Moscow is from Tomoko Young's fish room. She originally acquired the strain from Jim Heller. She has been crossing it into Micariff strains to enhance the yellow. Notice the red spot in the peduncle area. This is a very common feature of the Moscow. See the Red Spots article in the *Notes* section at the end of the Guppy Color Bank.

Genetics

For general comments about Moscow genetics, see *Moscow General Information* in Notes.

The genotype for this guppy is:

$XY^{(Mw)}$ b/b

Where Mw = Moscow, b = blond

Categories

Cat: Moscow; Cat: Blond; Cat: Red Spots

Snakeskin Roundtail

Snakeskin Roundtail. Photo Finn Bindeballe

Other Common Names
Filigran Roundtail, Snakeskin Round Tail

Description
The roundtail guppy has limited popularity in the U.S. where it is known as the Snakeskin Roundtail. In Europe, the round tail is much more popular. It goes by its old scientific name "filigran." According to the IKGH roundtail standard, the caudal fin must be round with a diameter 50% of the length of the body. The dorsal fin is supposed to be rounded and trail back to the base of the caudal fin.

Genetics
See the *Snakeskin General Information* entry for the genetics of the snakeskin pattern.

For a discussion of the *Roundtail Fin Shape* see the Notes section.

For a discussion of the black areas in the front of the body, see *Bandit Markings* in the Notes section.

Reference
See the entry for the IKGH standard.

Categories
Cat: European; Cat: IKGH; Cat: Red Tail; Cat: Roundtail; Cat: Snakeskin; Cat: EGI; Cat: Bandit Markings

IFGA Variegated Snakeskin

Photo by Philip Shaddock

Description

An IFGA snakeskin must have a distinct "chain-link" or rosette pattern over a minimum of 60% of the body. Fish displaying vertical bars in the body rather than the snakeskin chain link pattern (formally called "cobras") will compete in the appropriate color class. Ideally the pattern of a snakeskin should start at the base of the caudal, work its way through the peduncle and through the stomach to the tip of the nose. This pattern should have an underlining color behind the snakeskin pattern, the same as its caudal. A Green Lace Snakeskin should have an underlying body color of green. A Red Lace snakeskin should have an underlying body color of red.

A Variegated Snakeskin is a Snakeskin with 51% or more of its caudal fin variegated with a pattern. A evenly distributed chain-link pattern throughout the caudal is ideal. The color of the caudal should match the body color.

Genetics

See the *Snakeskin General Information* article in the Notes section for an extensive discussion of snakeskin genetics.

References

See the *IFGA General Information* page for information on the IFGA, its standard and breeding practices.

Categories

Cat: IFGA; Cat: Snakeskin

Red Lace Snakeskin

Picture by Philip Shaddock

History

Guppylabs author Robert Gall interviewed the creator of the German Red Lace Snakeskin guppy, Franz Zeipelt, for the October 2005 Guppy Labs e-Bulletin. Mr. Zeipelt began breeding the red lace snakeskin in 1976 using a male Singapore red variegated snakeskin from a LFS and a female from his own strain of half black reds. The female showed no black, since in his strain the half black is Y-linked. The first male offspring looked much like the father and did well at local shows. It was not until the mid-1990's that Mr. Zeipelt began showing them at international shows. Before that time there were no "red lace snakeskins" in Europe.

Mr. Zeipelt tried using IFGA blue delta females, evidently in an effort to create a blue lace snakeskin, but could never stabilize the strain. The lace pattern disappeared in and around areas of blue color. Similar results occured when other solid-colored strains were used, grey-bodied and otherwise. Mr. Zeipelt maintains both the yellow and red varieties of lace snakeskin, and highly recommends the use of grey-bodied, Y-linked half black red females for an out cross at the very first sign of clear areas in the caudal, or, worse, if tissue is missing in the caudal (often called "lyretail"). Mr. Zeipelt believes the gene for the lace pattern is Y-linked.

The strain of red lace snakeskin guppy seen in the United States may well be the product of a cross between a Russian Red Metal Lace Snakeskin of Detlef Samnet's strain and a normal lace snakeskin brought into the States by Luke Roebuck in 2001.

Description

The red lace snakeskin is a medium-to-large-bodied snakeskin with a very extensive and fine snakeskin pat-

tern covering at least 80% of the body. The caudal and the matching dorsal are burnt orange or orange-red and covered with a very fine lace pattern. The lace pattern is so fine that from a distance these fish appear to be solid color. Females are typically grey-bodied with a completely clear, un-patterned caudal and dorsal. The dorsal has the slightest hint of bleu while a slight red hue dresses up the caudal. Females are very stocky, and perhaps because of this their sons have a tendency to become "chesty."

Compare this guppy to a Green Snakeskin, the IFGA Variegated Snakeskin and the Bader Snakeskin.

Genetics

The lace snakeskin has similar genetics to the coarse pattern snakeskin. The snakeskin gene is dominant and sex-linked, and easily crosses over. Some people have written that the snakeskin pattern needs to be on both the X- and Y-chromosome for the lace pattern to appear. This would be consistent with a statement made by Dr. Jim Alderson in the September 1995 edition of the IFGA Bulletin. Dr. Alderson says that the lace snakeskin is derived from a coarse pattern Variegated Snakeskin through inbreeding. After three or four generations, about 10% of the males show the tight, dense lace pattern. What makes Alderson's statement consistent with the statement that the gene has to be on both chromosomes of the pair to show is that inbreeding might result in the chance occurrence of a snakeskin gene of both the X- and Y-chromosome. So the genetics of the lace snakeskin would be:

$X^{(Ssb)(Sst)}Y^{(Ssb)(Sst)}$

Where Ssb = snakeskin body; Sst = snakeskin fins

Note that the scientist Violet Phang has published a paper showing that there are separate snakeskin body and snakeskin fin genes. The fact that you can have solid finned snakeskins supports this finding.

Breeders Comments

Gregory C. Dickman

I find claims of the lace characteristic being either Y- or X-linked to be an oversimplification.

In crosses I have made to regular snakeskins, I have never had a lacetail appear in the F1. Whether or not the male or female was the parent with the lacetail did not matter.

Since the half black body feature appears to have cropped up in W.G. Phillip's strain of English Lace guppy, the first recognizable snakeskin, it is my hunch that the half black red females used by Franz Zeipelt carried this feature as X-linked. When crossed to the male Singaporian red variegated snakeskin, the F1 males did not show this trait, as Mr. Zeipelt informs us. Over a lengthy passage of time and many generations, I believe the lacetail trait "crossed over" to the Y chromosome in one or more males, and shortly thereafter the red lace snakeskin guppy was fixed in its present homozygous state.

Categories

Cat: Red; Cat: Snakeskin; Cat: Red Tail

Midnight Black Moscow

Black Moscow. Photo: Philip Shaddock

Other Common Names
Midnight Black Moscow or Thai Black Moscow

History
This particular strain was imported from Thailand, from a broker who called it a "Black Moscow."

Description
There are various strains that go by the name of "Black Moscow." However what distinguishes the strain shown in the picture above is the density and purity of the black and the fact that this strain does not have the "chameleon" quality of the usual Moscows. It is always constantly black, and does not fade to grey. It does not have the same degree of blue or green metallic color as Blue (or other solid) Moscows, but is rather a dull black.

This particular version of the strain has the long dorsal (the elongated allele or Fa).

Genetics
For general comments about Moscow genetics, see the *Moscow General Information* article in Notes.

For the genetics of the elongated dorsal see the Elongated Dorsal article in Notes.

See the Color Bank entry for the *Onyx Black Moscow* for a discussion of that version of the Black Moscow.

This strain was crossed (female) with a Hawaiian Blue Moscow (male) to discover its genetics. The first generation of the cross produced a lighter version of both male and female guppies. The second generation of the cross produced much darker males.

The F1 of a Hawaiian Blue male x Thai Black Female cross.

Buncha Midnight Black siblings

The F1 cross male (left picture) did not fade under the stress of being moved to the photo tank like a normal Moscow. Buncha Silskulsuk, who breeds this strain, has suggested that there is an autosomal allele involved in Black Moscows. Buncha sent us the photo on the right above. This photo shows siblings. This provides evidence that the midnight black color is due to a single gene.

It is proposed that the gene (or transcription factor) involved in the blackening of this guppy be called the "midnight" gene. The genotype of the Midnight Black Moscow is:

$XY^{(Mw)}$ mid/mid

Where Mw = Moscow and Mid =Midnight

Size and Fertility

This is a highly fertile, good sized and robust strain. This is remarkable because black fish usually suffer low fertility, small size and health problems. See the note on the Onyx Black regarding this.

Reference

See the Color Black in the Notes section.

Categories

Cat: Moscow; Cat: Black; Cat: Elongated

Bader Snakeskin

Bader Snakeskin. Guppy and photo: Philip Shaddock.

Other Common Names

Cobra Bar Snakeskin, Vertical Bar Snakeskin, Cobra, IFGA Coarse Pattern Snakeskin

History

Rick Grigsby

This guppy was originally from the U.S. breeder Rick Grigsby, who called them Bader Snakeskins because of their resemblance to an old snakeskin strain. That old strain no longer exists. According to Luke Roebuck, the strain segregated out of Half-Black AOCs. (HB AOCs have the snakeskin allele.) In the past the "Bader" qualifier was used to describe IFGA snakeskins with a coarse pattern (versus a lace pattern as in the case of lace snakeskins).

Description

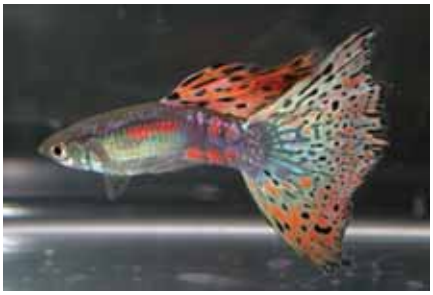
This strain is more properly called "Bader Type Snakeskin," since it has not been established that it descended from the original Bader Snakeskin. It has snakeskin markings on its whole body, plus vertical snakeskin bars in its peduncle. The bar gene that creates vertical bars in the peduncle also organizes the spots in the tail into vertical patterns.

Typically it is a green color. The black markings on the front of the body are typical. This particular specimen has a lot of vertical bars on its caudal. It is more usual for there to be six vertical bars.

Genetics

Grigsby says the Bader Snakeskin strain is highly inbred. He estimated in 2006 that they had been inbred 43 generations. This makes this strain highly valuable for out crosses as it is highly homozygous.

The vertical bar pattern in the peduncle and caudal is due to an autosomal recessive gene, the bar gene. The gene is often called "Zebrinus" for its zebra-like vertical stripes. See the Notes on the "Bar and Zebrinus" gene. It's clear from Winge's description of the gene and the outcome of crosses that the Zebrinus gene is autosomal dominant, not autosomal recessive like the bar gene.



IFGA Multi. Picture by Philip Shaddock.

Rick Grigsby has said he uses the strain to produce bi-colors in out crosses. You can see the type of guppy that this strain might produce by looking at the *IFGA Multi* entry.

Notice the spotted fins, indicating the presence of the snakeskin gene for the fins (Ssb). Also notice the vertical bars in the peduncle area. This is the expression of the bar gene in a non-snakeskin body strain.

The genotype of the Bader Snakeskin is:

$X^{(Ssb)\ (Sst)}$ Y bar/bar

Where Ssb = snake skin body, Sst = snake skin fins, bar = recessive bar allele

See the *General Snakeskin Information* article. See the *Red Lace Snakeskin* Color Bank entry for the genetics of lace snakeskins.

It is not clearly apparent in the picture above, but this strain does have black markings in the front of the body. See the *Bandit Markings* article in the Notes.

Breeders Comments

Philip Shaddock

Despite the fact the strain has been so inbred, it produces very healthy and fertile offspring. The strain I have does not eat its fry. I have had females drop in a five gallon tank with other females and a male and they do not touch the fry. This makes this strain easy to maintain in my fish room, as I do not have to devote more than two tanks to its maintenance.

The strain dropped a sport. It was a guppy that had no snakeskin markings!

Here is a picture of the Bader Snakeskin with no snakeskin markings on the body:

"Snakeless" Snakeskin

Comparison to its brother

The following observations can be made:

1. This is the first sport in three or four generations of inbreeding this line, in several hundred males. As far as I know this line has been inbred up to 50 generations, so the allele or gene is not the result of a recent outcross.
2. The snakeskin gene is lost in the body of the sport but not in the fins (at least the caudal fin). This confirms the finding in the scientific paper by Violet Phang that the snakeskin pattern on the fins and body are due to separate genes (Sst and Ssb). Interesting to note is that the snakeskin pattern is less or smaller in the sport's caudal compared to the snakeskin brother. I wonder if this means the snakeskin body gene (ssb) actually influences the fins. You do not see a snakeskin pattern in the sport's dorsal fin. This makes me think that the snakeskin body gene (ssb) actually is whole body, whereas the snakeskin fin gene is fins only, maybe even caudal only. This has implications for all other types of guppies, since they will perhaps have the same distribution.
3. At first I thought the snakeskin pattern was showing up somewhat in the body of the sport. If you look at the sport's peduncle, you will seem some shiny vertical patterns. Then I realized the slight vertical marks in the peduncle were due to the bar gene! What I have been wondering for a long time is if the bar gene could be expressed without the snakeskin pattern. Right now I have a cross that will test that. But I think I have my answer now! This means the vertical bar gene can be used to alter other patterns than the snakeskin. This was originally suggested to me by Rick Grigsby, the American breeder, but I have not had time to confirm it. The bar gene in this case seems to aggregate the iridophores into vertical bars. A tool in the guppy designer's tool chest! I am going to have fun with this gene, creating multicolor guppies.
4. The sport shows some markings in the same place as the brother, such as the platinum yellow /green shine in the front of the body and some black spotting. So these are not part of the snakeskin gene expression. A sport can tell you so much about the normal version of the strain.
5. There is some red spots in the peduncle of the sport that do not appear (or are weak) in the snakeskin brothers. Apparently expression of the red spots is suppressed in the snakeskin brothers. See the article on *Red Spots* in the Notes . It is very interesting that this spot should appear in this strain.
6. Another interesting observation is that the sport has very few iridophores (metallic color cells). It has some in the front of the body and some associated with the bar gene, but it has much less than the brothers. Since the snakeskin pattern consists of very thick alternating bands of iridophores and melanophores, perhaps the loss of the iridophores caused the snakeskin to collapse. However there does appear to be some aggregation of iridophores due to the bar gene. The bar gene seems to depend on the presence of the iridophores and melanophores for its expression. Is it an allele that re-organizes patterns rather than generating an over-production of color cells?

Categories

Cat: Snakeskin; Cat: Bar Gene; Cat: Green; Cat: Bandit Markings

Albino Yellow Snakeskin

Albino Yellow Snakeskin. Photo by Andrew Lim

Other Common Names
RREA Yellow Cobra

Description
This is a yellow snakeskin with the albino gene. Snakeskin is "filigran" in Europe or "cobra" in Asia. It appears to have the bar gene.

Genetics
See the *Red Lace Snakeskin* entry for the genetics of the snakeskin pattern.

The albino gene is autosomal recessive and is inherited according to Mendelian principles.

The genotype of this guppy is:

$XY^{(Sst)(Ssb)}$ a/a bar/bar

Where Sst = snakeskin tail, Ssb = snakeskin body, a = albino, bar = bar gene

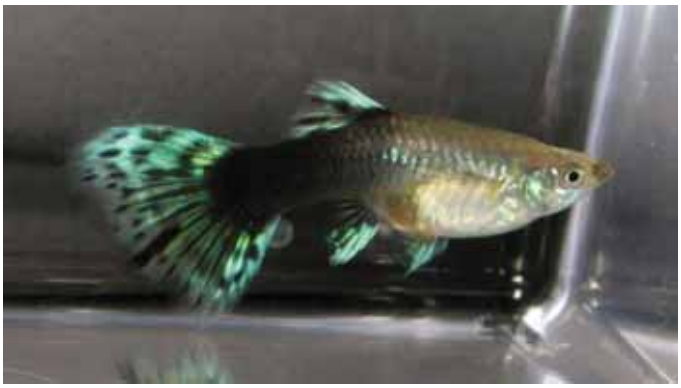
The snakeskin gene is dominant and can be X or Y-linked.

See the *Snakeskin General Information* article for more information on the history and genetics of snakeskins.

See the *Bar and Zebrinus* article in the Notes.

Categories
Cat: Albino; Cat: Snakeskin; Cat: Asian; Cat: Yellow

Spotted HB Female



Spotted HB Female. Photo by Philip Shaddock. Taken at an IFGA show.

Description
This is a fine example of a guppy in a female class at an IFGA show.

Genetics
The female has a dark half-black allele.

Categories
Cat: Female; Cat: Half-Black

Albino Neon Blue

Photo: Philip Shaddock

Other Common Names

Albino Blau

Description

This Taiwanese strain has the big body and fins of the American IFGA strains and the genetics of an Asian guppy. It is related to the common Singapore farm blue neon "tuxedo" guppy found in fish stores everywhere. But the use of American genes in combination with Asian genetics has produced a stunner. It is an albino.

Genetics

The particular strain we show above is actually a half-black red that has the Blue Neon mutation (called Asian Blau in Europe). It is also an albino. The combination of two autosomal dominant genes is usually called a "double recessive" or double mutant.

For a detailed description of breeding this strain, see the *Asian Blau* article in the Notes section.

The half-black allele is discussed in the Notes section.

It's genetic makeup is as follows:

$XY^{(Ni)}$ a/a Nb/nb

Where Ni = half-black, a = albino, Nb = Asian Blau

The Asian Blau allele is autosomal dominant (See *autosomal dominant* in the Common Genetic Terms section of the Genetics Appendixes.) When it is homozygous (Nb/Nb), it produces a white phenotype. When

it is heterozygous (Nb/nb) it produces a blue metallic phenotype.

Red body and fin colors are usually considered to be sex-linked and dominant to all other colors except black.

Breeder Comments
Philip Shaddock

You can make your own version of this strain by first crossing a half-black red with any of the strains that have the Asian Blau mutation, which is variously called the Asian Blau mutation or in Europe the rr2 mutation, and then crossing to an albino strain. Normally the suggestion would be to use the classic Neon Blue strain found in pet stores. But it has very poor body and fin shape and usually diseased.

The initial out cross (hb red to Asian Blau) should produce a blue metallic guppy. However, some people believe that the Asian Blau mutation may be selective in terms of the red pigment.

You should do a reciprocal cross, male of one strain to female of the other and vice versa. This will help ensure that you get the best body and fin characteristics from the two merged lines. In the F1 of the cross you will get about 100% blue guppies and no red guppies, due to the special nature of the Asian Blau mutation. (See the strain entry for the *Neon Blue*). The blue guppies are heterozygous for Asian Blau gene. In the F2 and subsequent generations you will get a percentage of blue guppies depending on the genotype of the females you mate with blue males.

Simply cross a blue guppy with an albino strain to arrive at the albino version of this strain. The best choice for an albino out cross strain is an albino half-black red or albino full red.

I maintain a "triple recessive" Super White (see the entry for this strain) for these type of out crosses.

An interesting variation of this cross would be to use a full red rather than half-black red for a fuller bluer color and no half-black ghosting.

Categories
Cat: Albino; Cat: Half-Black; Cat: Red; Cat: Asian Blau; Cat: Blue

Glass Belly Panda

Picture by Philip Shaddock

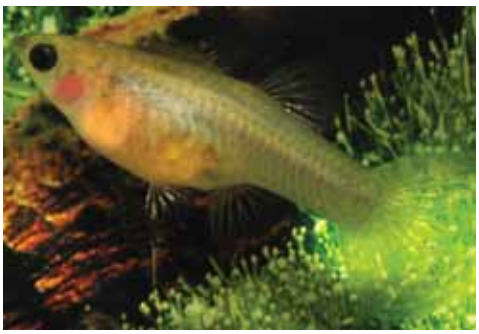
History

The breeder Chang Yi developed this strain from a cross between a Panda Moscow and a Glass Belly Grass guppy. He says it took him two years (from 2005 to 2007) to perfect the strain.

Description

This is a small strain. It has a short round caudal. Besides the typical Panda markings, the most obvious characteristic is the transparent belly. You can see the eggs and the eyes of the developing fry in the female's gravid spot area in the above photo. Also notice the lack of iridophores (reflecting cells). The eye is all black with no silver iridophores. There appears to be some iridophores in the front of the body, but the body generally lacks iridophores, a characteristic of the glass belly mutation.

Here is another picture of the same female as above:



Glass Belly Panda female.

You can see the eggs even better in this picture. It was taken four days after the female gave birth. You can barely make out the eyes of the developing embryos.

Notice also the blood showing in the gills. Normally this is an area covered by shiny iridophores, protecting it from the sun. The peachy color of the female is typical of this strain. The fry are born with this color.

Genetics

The strain is a combination of Panda and the Glass Belly alleles. Panda is the result of a cross between a male Mos-

cow and a Pink (or Pingu) guppy. The Glass Belly allele is autosomal recessive.

So the gene notation for this strain is:

$XY^{(Mw)}$ gb/gb k/k

Where Mw = Moscow, gb = Glass Belly, k = Pink or Pingu.

The existence of a white iridophore streak in the front of the body of the male seems to contradict the idea that the glass belly mutation affects iridophores. However, the iridophores that do show up in the Panda appear to be specific to the Moscow. They are probably mutant iridophores that are ectopic. This means they are not normal iridophores, appearing in skin layers and locations that are not true of the wild form.

However, there also appears to be slight amounts of iridophores throughout the body, including the eyes. The other possible explanation is that the Glass Belly mutation may have variable expressivity when part of the same genotype as the Moscow. Compare the Glass Belly Panda to the Albino Red Tail Glass Belly. In the Albino Red Tail Glass Belly strain there are zero iridophores expressed.

The other notable feature of this strain is that the dull black color on the male does not appear to fade, unlike the black usually found on Moscows.

Breeders Comments

Philip Shaddock

One of the "males" that showed up in a drop was this giant blue Glass Belly Panda.

This "male" is only four months old. He continued to grow and was the same size as the females at maturity.

The Blue Glass Belly Panda male is significantly larger than the regular Glass Belly Panda male. Compare the relative sizes of the males to the females in this picture and the picture at the top of the entry.

The most likely explanation why the Giant Blue Glass Belly Panda male should be so much larger than the regular Glass Belly Panda male is that the "male" has an XX genotype. Notice the shape and size of the XX male's body is closer to that of the female than the XY male of the strain. Masculinized males are a commonly observed phenomenon in the scientific literature. The guppy scientist Ö. Winge actually maintained a line over many generations that was entirely composed of XX males.

Categories

Cat: Moscow; Cat: Pink; Cat: Glass Belly; Cat: Triple Mutant; Cat: Black; Cat: Panda

Albino Glass Belly Red Tail

Picture by Andrew Lim

History
The origin of this strain is China.

Description
You can see the internal organs of this guppy.

For information on the yellow and red color cells, please see *Xanthophores / Erythrophores: Yellow and Red Color Cells* in the Notes section.

Genetics
The transparent belly trait is autosomal recessive. It has been applied to other strains.

For an extensive discussion the Glass Belly trait, see the Color Bank entry for *Glass Belly Panda*.

Categories
Cat: Albino; Cat: Red Tail; Cat: Glass Belly

4 Notes

A

Albino (RREA and WREA)

Albino Full Platinum female. Picture by Philip Shaddock. You can see a bit of platinum gold color on the body, because albinism does not affect light-reflecting iridophores. There are also silver iridophores in the belly area of the female and white iridophores in the fins.

Description

An albino guppy cannot manufacture black pigment. In the albino guppy you see in the picture above, the loss of black means that you get a yellow guppy with white and silver highlights. The white and silver iridophores and the yellow color cells are unaffected by the albino mutation.

An albino has red eyes, instead of black eyes. The eyes are red because of the red blood in the eyes is not masked by black melanophores. Asians call albinos RREA (Real Red Eye Albinos) because not all types of albinos are completely missing black pigment. Some albinos make enough black pigment (melanin) such that the eyes are a dark red or "wine-colored" red like this guppy:

This "super white" guppy has the albino mutation, plus the Asian Blau mutation that causes a failure of the yellow xanthophores to form. That is why the guppy is white instead of yellow. Picture courtesy Uthen Chaichot.

Notice that the eye is darker than a RREA albino. Such a guppy is called a WREA (Wine Red Eye Albino). Another name given to a dark eye albino is "Ruby Eye Albino."

Genetics

The albino gene is autosomal recessive to its wild-type allele. See the *Autosomal Recessive* entry in the Genetics Appendixes "Common Genetic Terms." The entry provides an example of how the recessive autosomal albino gene is inherited.

Black pigment is manufactured in a series of chemi-

cal steps in the cell. Each of these steps is catalyzed by an enzyme. Any one of these enzymes can be faulty. This means it is possible to have up to eight different types of albinos. When such albinos are crossed, they produce grey guppies, because the correct enzyme translated from a gene on one chromosome compensates for the faulty enzyme translated from a gene on the other chromosome.

Symbol

The symbol for an albino allele is lowercase "a." So an albino has the genotype:

a/a

Where a = albino.

Asian Blau Mutation

The Asian Blau mutation is known for its effect on the color red in guppies. Guppies heterozygous for the Asian Blau mutation have a bright metallic blue in place of red color cells. In the homozygous state the guppy is a dull black and grey color with blue flecked fins. The Asian Blau is known as the r2 Blau mutation in Europe.

The Asian Blau mutation is autosomal dominant. (See *Autosomal Dominant* in the Common Genetic Terms section of the Genetics Appendixes.)

It is not true that the Asian Blau mutation only affects red color cells! If the guppy inherits two copies of the Asian Blau mutation, yellow color cells, some black color cells, and the iridophores are affected! Here is a comparison between a homozygous blau Galaxy (top picture) and a heterozygous Galaxy (bottom picture).

Galaxy homozygous for Asian Blau

Blue Galaxy heterozygous for Asian Blau

We have no picture of a Red Galaxy, but that would the third picture. A red colored fish would have NO Asian Blau genes. The top picture shows a Galaxy with two copies of the Asian Blau gene, and the metallic blue guppy in the picture below shows the heterozygous guppy, the one with one copy of the Asian Blau gene and one copy of the normal gene.

If you combine the albino and Asian Blau mutations, you get white instead of yellow guppies. That's because when the Asian Blau mutation is homozygous yellow color cells fail to develop.

Breeding Asian Blau versions of red guppies is really quite simple once you understand the biology and

genetics of the mutation. Since it is very difficult to distinguish between the different types of females, choose the Asian Blau version of the guppy and breed him to his sister. This will produce a mix of offspring, including wild-type, heterozygous and homozygous. This works because the mutation is autosomal dominant, you will always get Asian Blau males no matter what female you choose to breed him to.

Gene Symbols

We have adopted the gene symbol Nb for the Asian Blau mutation. This is an acronym for "neon blue," the metallic blue color of the mutation when the Asian Blau mutation is heterozygous. Here are the symbols:

- Nb/nb = metallic blue trait of the heterozygous Asian Blau guppy
- Nb/Nb = white trait of the homozygous Asian Blau guppy
- nb/nb = wild type with no Asian Blau allele

B

Bandit Markings

Heterozygous Blau. Photo by Luke Roebuck

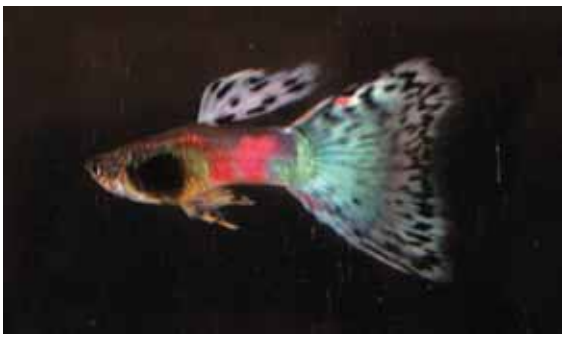
Uwe Bergmann, a long time breeder of the Galaxy strain, first pointed out to us the link between the black markings seen on the Galaxy in the above photo and the black splotches of melanophores seen in the homozygous blau version of the Blue Galaxy.

Homozygous Blau version. Photo by Philip Shaddock

Obviously the spots on the grey version are due to the same gene as the areas of dark, dull black on the blau version.

The blau Galaxy has the Asian Blau mutation, which affects all color cell classes (red, yellow, iridophore and black) when it is homozygous. The black color cells in the front of the body of the blau Galaxy are the exception. This is probably due to the fact they are mutant and ectopic. Apparently they are dominant over the snakeskin pattern in the front of the body and they escape modification by the blau mutation.

It is interesting to note that the Moscow also appears to have ectopic black color cells in the same area of the body. The area of dull black appears when the Moscow has the golden (U.S. bronze, Asia tiger) mutation (next page).



Golden Moscow

This area of the Moscow is dominant in many crosses, variously showing as a blue metallic sheen in the front of the body or a dark black area or a marble pattern.

Another strain of guppies that appears to have the bandit markings is the Santa Maria. The strain is defined by the area of bluish black color.

Santa Maria, courtesy Yours Young

It seems the majority of guppy strains that show this pattern in the front of the body are snakeskins or strains with snakeskin genes. See the *Yellow Snake Spade*, *Emerald Green Snakeskin Doublesword*, and *Variegated Emerald Green Double Sword*. Other examples include the *Yellow Grass,* and *Japan Blue*.

Bar and Zebrinus Genes

Description

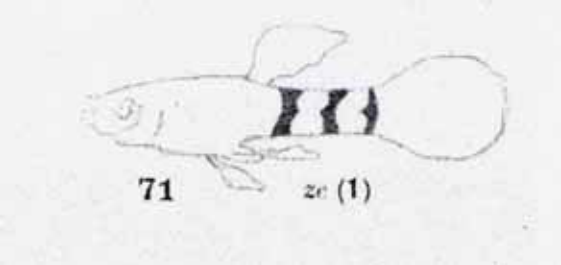
The bar gene is an autosomal recessive allele that organizes color on a guppy into vertical bars. In some cases it appears to affect both the body and fins. You can see the effect of the bar gene in the above picture, especially in the vertical stripes in the body and the vertical arrangement of dots in the caudal fin. The gene affects non-snakeskin guppies as well as snakeskin guppies. This IFGA Multi guppy is obviously the result of a cross between a snakeskin with the bar gene and a non-snakeskin.

IFGA Multi. Taken by Philip Shaddock at a guppy show.

You can see the vertical bars of color in the peduncle of this multi-colored guppy. One interesting value of this gene for the guppy designer is the ability to create multi-color guppies with vertical patterns in the peduncle.

The Zebrinus Gene

The bar gene differs from the Zebrinus gene described by the Danish guppy geneticist Ö. Winge as autosomal dominant. Here is the graphic Winge created to illustrate the Zebrinus pattern:



Notice that Winge says the Zebrinus gene creates a "barred pattern of vertical stripes in the tail," yet his figure shows stripes only on the peduncle.

See the *Bader Snakeskin* Color Bank entry for further information on the bar gene.

Blond and Golden Mutations

Blond Japan Blue. Notice the yellow cast of the body. Wild-type guppes have both yellow and black color cells covering the body. When black is removed the yellow color is more obvious.

This article discusses the blond and golden mutations affecting black color cells (melanophores). Black color cells are described in the *Melanophores: Black Color Cells* Note.

Golden female. You can see why Americans describe this strain as "bronze." Nico Roselli photo.

Naming Conventions

The two mutations are known by various names around the world. Here are the equivalent names for the same mutations.

Genotype	Scientific	USA	Europe	Asia
gg	Golden	Bronze	Gold	Tiger
bb	Blond	Gold	Blond	Gold

Color Cells Affected

The wild-type or normal guppy has the diamond-shaped pattern of black color cells. Both blond and golden mutations affect the size and distribution of black color cells. The blond mutation makes black color cells so small as to be practically invisible.

The golden mutation removes black color cells from

the area between the typical reticulation pattern of the guppy and increases the size and density of the color cells in the reticulation pattern.

Blond Guppy

A guppy with this mutation looks like an albino with black eyes instead of pink eyes. The other pigment colors, red and yellow, become very light and pastel because they are not backed by black color.

Blond IFGA Pastel. Notice the very light grey half-black area.

Looking at the blond mutation under the microscope, we see that the black color cells are actually present in the skin and have black pigment in them. They just fail to develop beyond a certain size. And they are reduced in number and density. The black color cells are so tiny and thinly and evenly distributed they cannot be seen by the naked eye.

Golden Guppy

The golden mutation enlarges black color cells, reduces their number, and moves them to the scale edges, creating spaces in between. It accentuates the reticulated pattern of the guppy. It selectively affects the black color cells on the guppy, producing this phenotype in Moscows:

Luke Roebuck

You can see part of the golden female Moscow at the bottom right of the screen. Her coloring is the classic distribution of black color cells: larger and fewer at the scale edges.

Selective Effect of the Blond and Golden Mutations

The males show a bit of heavy reticulation, but in the front of the body and peduncle they have large areas of dull black color. This shows the selective affect of this mutation. The blond mutation is also selective, producing blonds with half-black peduncles.

Half-black blond guppy. Photo by Philip Shaddock

See the *Autosomal Recessive* entry in Common Genetic terms for the breeding of these mutants.

Blue Diamond or Luster

Junichi Ito, who supplied this picture, calls this guppy strain "Luster."

Description

The Japanese Luster strain may be the same as the Asian Blue Diamond strain. The gene covers the body with a light, metallic blue. You can certainly see this effect in the above picture.

Most of the blue on guppies is due to blue light reflecting cells called iridophores. So the metallic blue you see on the guppy above is the result of the proliferation of an arrangement of these iridophores. See the Iridophores: *Metallic and Platinum Colors* article in this Notes section. The gene is said to be Y-linked. Presumably it crosses over.

C

Coral Red

Other Common Names

Neon Red. The Neon Red got its name because of its resemblance to Neon Tetra.

Coral Red guppy. Picture provided by the late Häkan Turesson and used with permission. He commented on these coral reds: "This picture shows some of the best shaped double swords I have ever seen. It is coral red on top of Viennese Emerald Green [ed. Wiener Smaragd] genes. I am just the photographer, the breeder is a friend of mine, Martin Berntsen in Lund, Sweden.".

History

The developer of the Coral Red mutation is attributed to Erwin Renner in Vienna, Austria. The strain originated from Viennese Emerald Green Swords (Wiener Smaragd). His original strain had a blue front of the body with red metallic in the peduncle area, hence the name Neon Red. He is said to have given up on the strain. Hans Luckmann (Wunstorf, Germany) took it on in his place. He improved the grey strain and made it popular among breeders again. Ömer Gülmez then acquired the strain and crossed them to the albino Red Delta females from Ed Richmond of New York city. After breeding them several generations he finally got appealing Coral Red Doubleswords from the cross. He entered them in a show in Sweden where Häkan Turesson acquired them and out crossed the strain to Wiener Smaragd Doublesword females. The females were from a strain developed by Robert Kratochwil (Austrian Guppy Association, ÖGG).

This cross improved the albino swords dramatically and Häkan Turesson became renowned for them. This color has been used to create a new strain of Full Red guppies. The color looks very good on blond (IFGA gold) guppies. Another interesting

version is the Albino Neon Double swords.

For a better picture of a different Coral Red and Emerald Green Iridescent combination, see the *Coral Red* entry in the Color Bank. The picture captures the metallic quality of coral red better than this article's picture.

Genetics

Coral Red is Y-linked. One of the points of difference between American Reds and European Reds derived from Coral Reds is that American Reds are said to be autosomal recessive, instead of Y-linked.

Crossing Coral Reds with Schimmelpfennig swords produces a double sword with a deep yellow color.

The gene notation for Coral Red is Co (dominant Y-linked).

Breeders Comment

Luke Roebuck

Luke Roebuck comments on the difference between U.S. Reds and the Coral Reds. "Most people cannot tell the difference between U.S. Reds and Coral Reds by looking at older fish, but you can tell from the development stages of the strains as they grow. The Coral Reds look markedly different from the American deltas and they color up differently."

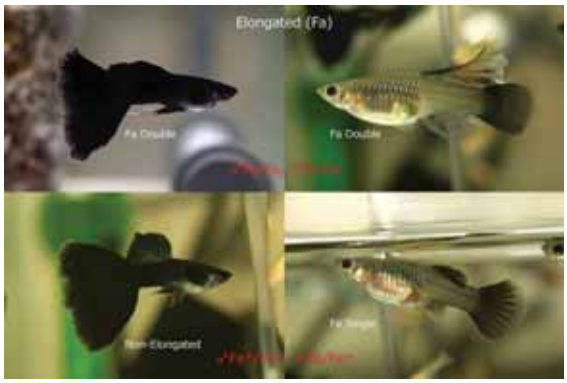
The Japanese have been experimenting with Coral Red doublesword crosses to other strains, such as Cobra. Claus Osche (a German breeder): "The better Coral strains I see today are the Blue and blue Glass variations [which are no longer red]. Maybe the crossover linkage has been broken to get the better dorsal in the new variations. I think the Japanese used these swordtails to inject the Coral gene or genes in too many strains, and this may be what caused the short dorsal. This is just a speculation. I know the Coral strains come in several varieties now. "

E

Elongated Dorsal (Hi-Fin)

Other Names

Also known as Hi Fin or Hi-Fin.



Genetics of the Elongated trait. Graphic courtesy Junichi Ito

Junichi Ito, a Japanese breeder, was kind enough to provide us with the genetics of the elongated dorsal.

The gene is dominant, but it behaves differently whether it is inherited heterozygous (one elongated allele and one normal allele, or Fa/fa) or homozygous (Fa/Fa). So when both alleles are elongated (Fa/Fa), the dorsal is very long. When only one allele is mutant (Fa/fa), the dorsal is still long, but shorter than when both alleles are mutant.

The elongated allele may be a mutant form of a gene that prevents the dorsal from growing longer. When both alleles of a pair are mutant, the fin grows unchecked. When one allele is mutant and the other is normal, enough protein is made to stop, but not completely stop the lengthening of the dorsal.

See the *Black Moscow* entry for further information. The gene symbol we use is Eld. Fa is reserved for the Fantail fin shape.

Emerald Green Iridescent

You can see emerald green iridescent color at the base of the peduncle on this sword guppy, as well as in the body, where the angle of the light makes it look blue. Photo by Finn Bindeballe. Taken at a Danish guppy show in 2007.

History

The Emerald Green Iridescent gene is named after the Dzwillo laboratory strain (Smaragd Iridescens) cultured by M. Dzwillo in the 1950s. Dzwillo in turn named his strain after the Iridescens strain described by Winge in 1927 in his "18 Genes" paper. (See the entry for *Iridescens* in the Laboratory Strains online. Also see the *Smaragd Iridescens* entry in the Laboratory Strains library.)

Smaragd Iridescens. Photo by Harald Auer. Presumably the blue patch of color at the base of the peduncle showed emerald green in other lighting. The iridescent sheen spreads throughout the body.

Description

"Smaragd" is German for "emerald." This picture of a raw emerald gemstone shows the particular quality of the emerald green.

Emerald gemstone picture from Wikipedia.

While the emerald green color is most obvious as a patch of iridescence at the base of the peduncle, the gene exerts its influence over the entire body.

Genetics

The black streak, red dots, black dots, green patch at the base of the peduncle and the overall green sheen to the body form a supergene. (See the Common Genetic Terms section of the Genetic Appendixes for a discussion of *Supergene*.)

There is one curious anomaly. Apparently the green iridescent area at the base of the peduncle has crossed over. On the next page is a picture of a female that developed as a male, adopting the gonopodium of the male and showing her X-linked colors. Her genotype is XX so she is missing the Y-chromosome where the supergene would be located.

The Emerald Green Iridescent gene and the snakeskin gene appear to be co-dominant. See the *Emerald Green Snakeskin Doublesword* entry.

Notation

Mr. Auer gives the iridescent metal color of his Dzwillo strain a different genetic symbol than Winge

(SmIr instead of Ir).

XX male with the green iridescent spot

$XY^{(SmIr)}$

Where SmIr = the Emerald Green Iridescent gene.

XX male with the green iridescent spot

F

Fantail Fin Shape

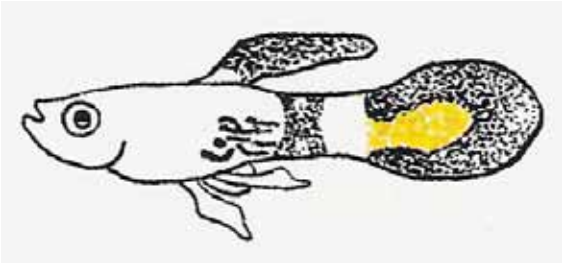
Fantail Fin Shape. Photo by Philip Shaddock

A shape favored by many Asian breeders.

Genetics

The shape is considered to be X-linked dominant. It's notation is Fa.

Flavus



Flavus (from Kirpichnikov)

Description

The Flavus pattern shown above has been studied by scientists, particularly Nayudu and Hunter in their landmark guppy paper, "Cytological Aspects and Differential Response to Melatonin of Melanophore Based Color Mutants in the Guppy, Poecilia reticulata" (*Copeia*, 1979(2), pp. 232-242). They found that the Flavus and Nigrocaudatus II genes created mutant black color cells: "composed of melanophores different from wild-type and distinguishable by various developmental and morphological characteristics." (p. 232). It is described as a "domestic" rather than wild-type pattern. It was first described by Winge and Ditlevsen in 1947.

Genetics

The Flavus gene (Fla) can be X- or Y-linked.

Full Red

Description

Full Red describes a guppy that is as close to 100% red as possible. The belly area on some Full Reds are still white, but even this area should be colored.

Ed Chiasson's Full Red guppy

The article on wild-type red spots focuses on those red spots found on wild guppies and many modern strains. This article focuses on red that covers zones of the guppy body, like the guppy at the top of this page. Indeed, some people argue that Full Reds, guppies that are entirely red, are really made up of many red genes, not a single full body red gene. Oscar Inostroza's experience in crossing a Purple Moscow male with an Albino Red female, producing a Full Red Moscow after only three generations, seems to support this theory. (See the *Albino Red Moscow* entry in the Color Bank.)

Oscar's F2 Cross. In only two generations blue has become red, in all but a few areas.

The Singapore breeder Patrick Ang has a different view. He thinks the Full Red is a mosaic of color genes. Here is his Full Red Guidelines which he posted on the Guppy Talk forum for the benefit of fellow full red breeders. (Reproduced here with his permission.)

Patrick Ang's Full Red Guidelines

1. Select those females with solid red color tail and dorsal fin.
2. Preferably select females with a red stripe on the side of the body. This is the key to getting the full body cover (Full Red).

Female Showing Red Stripe

Remember that a number of genes influence red color on a guppy. The red stripe on the side of the females is a recessive trait which will enhance the offspring's full red expression if it is matched to the same recessive gene on the male.

As for male selection, it's a no brainer right? Use the male showing the most FULL RED coverage who also has good fin shape and length.

The Red Color Zones and Their Genes

Patrick divides the red guppy into overlapping body zones and identifies the genes influencing those zones. (Calling these areas "zones" is something we have added to the discussion):

- **The American full red zone:** flows down from the side of head, but does not cover the top of the head. It covers the stomach area extending forward.
  Gene: autosomal recessive

- **The red side stripe zone**: extends from the back of the eye, flows downward to the side of body and does not cover the top of head and the lower stomach.
  Gene: Y-linked
- **The red head zone**: covers the top of the head, starting from the "red side stripe" and continuing behind the eye. It does not cover the lower stomach.
  Gene: Y-linked
- **The platinum / coral red zone**: flows downward from the "red side stripe" to the lower body. It does not cover the top head area and does not cover the lower body totally.
  Gene: Y-linked
- **The red full top zone**: covers the area from the mouth to the eye.
  Gene: autosomal recessive.
- **The red caudal fin zone**: both male and female fish selection will affect the offspring. The key is to select breeders with a BIG BIG tail and a solid red color.
  Genes: both Y- and X-linked
- **The dorsal fin zone**: mainly influenced by the female, so selecting big red dorsal fin females is key.
  Gene: X-linked.

Patrick" "If you want the stomach zone fully covered with red, both the female and male need to have the gene (homozygous). This is why I recommend selecting a female fish with a side stripe phenotype. Bear in mind that the side stripe on the female can represent either the American full red trait, the red side stripe trait (due to cross over), platinum red (due to cross over), and so on. So the first step is to get a female that looks like the picture above. With this phenotype you have some chance of getting the full red body coverage.

Now you understand why full body red coverage is so difficult to get right. The area of the body that results in "full coverage" is autosomal recessive and you need to keep selecting the right males and females to maintain that coverage."

What Patrick provides is a genetic toolkit for building full red guppies. His observations about the division of the body into zones, each governed by a gene, provides some empirical evidence of the way guppy color patterns are inherited and develop. We think Patrick's observations can be generalized to other guppy strains.

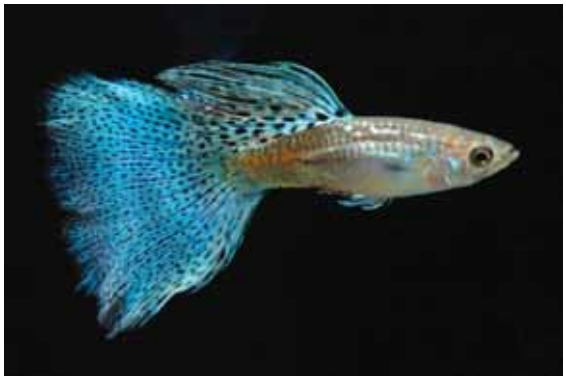
Further evidence for this zone theory is Ed Chiasson's development of the true Full Red guppy, one with red on the belly. It was the last zone of the body to fall to the proliferation of red color cells in the body.

References

For a discussion of red color cells, see the Notes section under Xanthophores / Erythrophores: Yellow and Red Color Cells.

G

Grass Guppies



Picture by Andrew Lim

History

The classic Japanese Grass guppies date back 30 years. The grass pattern on the fins has its origins in the mosaic pattern on Singapore guppies imported from Singapore in the late 1960s. The Mosaic pattern may have originated in Germany. A guppy with the mosaic pattern looks like this:

Mosaic Guppy

The mosaic pattern has an interconnected pattern. Japanese breeders refined the pattern into an array of dots (see the picture at the top of the page). Grass-type guppies have small dots, when the dots are larger, they are described as Leopard.

Description

The grass family of guppies originates in Japan and is characterized by a series of dots in the fins, sometimes against a transparent background, and stripes in the body.

Westerners are often confused by the names glass and grass. Glass refers to the transparent background to the fin. Grass refers to the fine pattern of dots on the caudal. A picture from Noboru Iwasaki (Guppies: Fancy Strains and How To Produce Them, 1989) shows what a "Glass Grass" guppy looks like:

Glass Grass Guppy

The Glass Grass strain is the only one that has the word "glass" in it. All other strains fall under the term grass.

The Blue (and related Red) Grass guppy is a classic Japanese strain that traces its origins to the Singapore Mosaic and Neon Blue strains. It comes in a variety of colors. The Blue Grass was originally bred by Yutaka Kishima from Kawasaki City, Kanagawa Prefecture. He is a chairperson of Kokusan Guppy Aikoukai (Japanese Guppy Enthusiast Club).

Besides the Blue, Red, Yellow and Multi Grass variations, there is another popular version of this strain, the Full Metal Blue Grass. This is essentially a Blue Grass that has been crossed with the Moscow. There is also a golden version of the strain, called Tiger in Japan. The metal gene has been added to give this version a metallic sheen.

Larry Hollingsworth's Albino Blue Grass, a popular version of the strain

According to Noboru Iwasaki in his book, Red Grass has been produced by crossing with the Red Mosaic. Yellow Grass comes from crossing with the Leopard.

The Blue Grass strain resulted from a cross with Neon Blues.

Neon Blue guppy.

Genetics

Iwasaki on breeding: "Choose a male whose caudal is not black and whose design is uniform across the caudal. A round-tailed plain female is best. Red Grass are early developers. When you cross a Red (Shibame) Grass and Mosaic, a fish between the two is produced. The line breeds true. Blue Grass are a newer strain. Choose males with spotted caudals on a pale blue background. Choose females with rounded, clear caudals. Those with slightly elongated upper caudal section have Mosaic blood. Females with rounded or egg-shaped caudals are best."

The one question remaining is the patterns on the body. We have not seen discussions of the strange streaking in the body. The Japanese focus is usually on the dotted fins, so they may not consider the body important. But from a genetic point of view, the streaking of most of the grass strains we have examined suggested it might be under the influence of snakeskin genetics. We think the mosaic and grass patterns in the fins are due to the snakeskin fin gene (Sst). The streaks on the body may be an effect of this gene. So is the Grass (and related Glass) gene largely a fin mutation?

In any event, the Japanese love crossing this guppy. It has been crossed with the Moscow, the snakeskin (called cobra in Japan), the galaxy, Japan Blue and so on.

H

Half-Black or Ni (Nigrocaudatus or Nil and Nill)

The half-black pattern, covering the peduncle area from the leading edge of the dorsal fin to the base of peduncle, is also called "tuxedo" in Asia because of its resemblance to a person wearing a tuxedo.

The half-black allele responsible for the pattern is sex-linked, meaning it is found on the X- or Y-chromosome. It readily crosses over. It is most commonly found on the X-chromosome of IFGA guppies. Another common feature of the X-linked IFGA half-black gene is that it is usually associated with a gene that lengthens the dorsal fin.

Guppy researchers like Nayudu and Haskins note that the half-black pattern is one of the only secondary sex characteristics that appears at birth. Normally guppy colors and fin shapes develop well after birth.

The half-black allele is usually described as dominant in the popular guppy literature. For example, crossing a half-black guppy with a snakeskin (filigran or cobra) guppy produces what Asians call the Dragon guppy, or the IFGA the Half-Black AOC.

Picture by Philip Shaddock. Taken at an IFGA show.

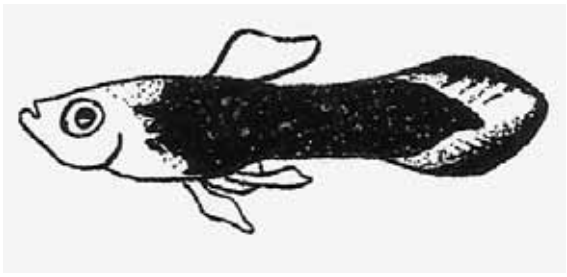
Notice the snakeskin pattern barely visible in the front of the body. The half-black gene causes the snakeskin pattern in the fins to become large dots.

The half-black gene was first described scientifically by Nybellin in 1947, who called it Nigrocaudatus. The scientist Dzwillo described an allele of the half-black gene which he dubbed NiII.

The genotype of a half-black guppy is usually represented as Ni, which is the gene designation given by the original scientific description of the allele (Nybellin 1947). It was called Nigrocaudatus (black caudal). So the most common form of the genotype in American strains is:

$X^{(Ni)}Y$

Where Ni = Nigrocaudatus



Nigrocaudatus Lab Guppy. Illustration by the Russian Geneticist Kirpichnikov

The Black Gold Strategy

The blond mutation (called gold in the U.S.) is one of many mutations affecting black color cells. Breeders use the blond mutation to lighten the body color in half-black strains, without lightening the half-black color cells themselves.

The Saddleback or Half Tuxedo

There is a type of pattern where the half-black pattern is bisected horizontally. It appears to be a genetic trait rather than a developmental trait.

See the *Half-Tuxedo Snake Speartail* entry.

References

See the *Onyx Black Moscow* entry in the Color Bank for the possible effect of the NiII version of the HB allele on Moscow strain color.

See the *IFGA HB Green* strain entry in the Color Bank for a possible example of the NiII HB phenotype.

For some interesting observations about the interactions between the half-black allele and red guppies, see the *IFGA Half-Black Red* entry in the Color Bank .

I

IFGA General Information

The IFGA (International Fancy Guppy Association) is the only national guppy association in North America. It was formed about four decades ago. It maintains a judging standard that divides guppies into color classes and uses a point system to evaluate if show entries conform to the standards for body proportion, fin length and shape and health. There are regional guppy shows hosted by local clubs and an annual. Members compete for honours in guppy classes and overall guppy male and female champi-

onships.

Stan Shubel teaching a new generation of judges in the year 2000.

The judging standard and guppy classes are tightly controlled by the judging board. The advantage of this to members is that the standard has remained little changed over the years, creating a target that never moves. New guppy strains (like the Moscow) that are not the product of the standard have been resisted in the past because they are not homegrown.

A typical specimen produced by the standard.

The IFGA judging standard can be summed up as promoting a large-bodied guppy with long flowing dorsal and caudal fins. The dorsal and caudal should be matched in terms of color and pattern. The main colors and patterns found at shows are the solid colors red, yellow, green, blue, purple, pastel and black. Pastel is a kind of pink cream color. Size and body proportions are heavily rewarded in the point system, with only a point or two going to a fully colored guppy. This has resulted in largely grey-bodied guppies with intense colored fins. Half-black guppies are probably the most prevalent at shows. Mutant colors are also found, including snakeskin, golden (called bronze in the IFGA), and blond (called gold in the IFGA). The caudal fin color is a determinant of the guppy's show class. There is also an AOC (any other color) and bi-color and multi-color classes. There are three basic tail shapes at shows: the triangular shape delta, a slightly narrow triangle version called "veil," and swordtails, including single and double swordtails. An attempt to get a short tail guppy class going apparently failed.

Of the possible 100 points that a male guppy can earn, 27 points are earned for maximum size and 27 points for maximum color. The IFGA classes have been fairly stable over the last three decades, although the number of classes has grown.

If you enter your guppy in an IFGA show, and it is disqualified, the reason will lie with one of the following four situations:

- The guppy did not meet the minimum standards for the class.
- The guppy was dead.
- The guppy's caudal shape was not a recognizable IFGA shape (delta, veil or swordtail).
- The guppy did not meet minimum show standards. For example, it was less than ½ inch long.

Guppies must be born and raised in your own tanks to qualify. Buying the Best of Show winner from another breeder and entering it at another show is not allowed. If the female drops fry in your tank,

they are fair game.

For people who enjoy competition, the IFGA offers an opportunity to pit your breeding skills against other's. Some people have easily won classes by buying a strain from a current championship breeder of the strain, but the long term champions have a good basic knowledge of selective breeding practices and lots of tank space (a minimum of 12 tanks per strain) and the time to learn the standard and select breeders.

Shark Red Tail Female. This type of female is reputed to produce males with superior caudals. Picture taken at IFGA show in 2000.

One of the reasons the IFGA has survived so long it that it keeps things simple. The guppies are genetically simple. Platinum and Stoerzbach metal style guppies are virtually unknown, along with the popular Magenta and Asian Blau strains. Breeders tend to follow formulas passed down by successful show circuit champions. The main practice is selective breeding and a form of inbreeding called line breeding, where several lines of a strain are kept, each with a piece of the conformation puzzle. Breeders "put together" the lines to create hybrids that have all the desirable traits.

The longevity of the organization and its standard has resulted in strains that are remarkably homozygous, with relatively little variation when compared with wild guppies or strains from other parts of the world. For breeders not interested in competing at shows, IFGA strains make excellent crosses to compatible colors, as between Blue Moscows and IFGA solid blues. The relative stability and predictability of IFGA strains makes it easier to disentangle their influence in a cross.

In a discussion on the IFGA forum in December 2007, leading breeders such as Dr. Jim Alderson, former IFGA president Tom Allen and award winning breeder Tim Mousseau concurred on the number of tanks (8-12) required to build and maintain a champion strain of guppies. However, Dr. Alderson said that the more tanks you have, the more flexibility in this average number. The number of tanks assigned to a particular strain fluctuates over time.

The bottom line is that competing at guppy shows requires a serious dedication to tank space.

For a discussion about the differences between the IFGA and IKGH (European) judging standards and the typical guppy they produce, see Dr. Cellerino's comments in the *IKGH General Information* article.

IKGH (European) General Information

The information in this overview of the European guppy standards is derived from Kempkes' book "Der Guppy." Ulmer Verlag, Stuttgart, 1996, used as a reference by Dr. Alessandro Cellerino, who authored major sections of this chapter.

Europe has many guppy clubs. The individual European clubs and societies united their judging standards into the Internationale Kuratorim des Guppyhochzuchtes (IKGH). The standards are updated on a regular basis to allow for the creation of new classes corresponding to new colors.

The major differences between the American IFGA (International Fancy Guppy Association) and the European IKGH standards are the much higher number of classes allowed by the latter and the rela-

tive weight of points assigned to the body size, color, and proportions. This results in a guppy with quite different body proportions to the American standard. In general, the European fish is slimmer and its caudal is shorter. More intense color is favored.

Typical European body and fin style.

In the IKGH competition only trios of males are judged. There are no categories for single male, tank (pairs), breeder males (5 males) and there are no female classes.

The IKGH recognizes 12 different standards of caudal fin shapes. The classes fall into three groups, large fins, swordtails and short tails.

Large Fins

Veil

Triangle (Delta)

Fantail

Scarftail

Swords

Uppersword

Lowersword

Lyretail

Doublesword

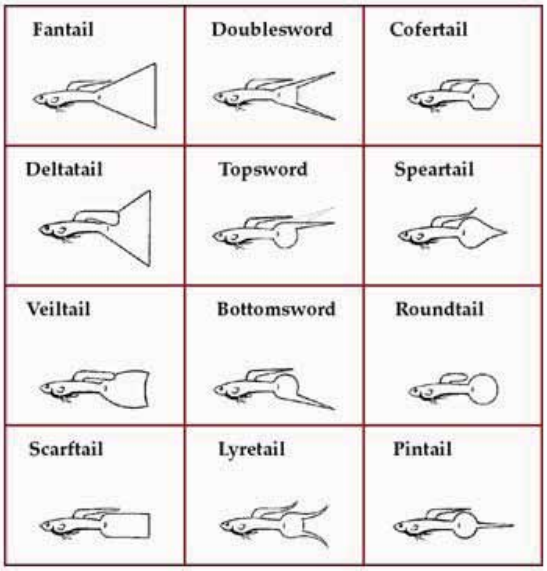
Short Tails

Roundtail

Pintail

Speartail

Coffertail



Most of the guppies entered at exhibits are Triangle or Doubleswords. The most exotic fin shapes, such as Pintail and Scarftail, are relatively rare entries, at least at the time of this writing (2007).

The IKGH puts particular stress on the well-being of the fishes. It has effectively banned the long delta when the fish's ability to swim is compromised. For this reason, the ideal proportion of the European delta tail is 80% of the length of the body. (See below how the Europeans measure the body. It differs from the IFGA standard.) Points may be detracted if the tail goes beyond the 8:10 ratio. Ideal body size for the IKGH standard is 26 mm (almost exactly one inch). If the body size is larger than 26 mm, no extra points are awarded. The maximum body length is 25 mm for doubleswords and 24 mm

for shorttails. If the fish is longer you will loose up to three points Balanced proportions of the guppy is considered to be the most important attribute for judging.

Alessandro has studied the difference between the two standards. "The IFGA and IKGH are very similar in the percentage of total points allocated to body, dorsal and caudal. However, major differences are apparent when the relative weighting of points for size, shape and color are compared. The IKGH standard always allocates fewer points for size and more for shape or color. In the case of caudal, for example, caudal shape is responsible alone for 50% of the total caudal points.

This encourages the European breeder to focus on the ideal proportions of the fish and accuracy of colors, since the maximum size requirement is relatively easy to achieve, at least when compared to the American standard."

The Point System

The point system for IKGH guppy judging is as follows:

Five judges evalutate guppies in each category. Every single entry is pointed by each individual judge, unlike the IFGA where teams of judges work together and guppies are only pointed if two guppies competing for a place (1st, 2nd or 3rd) are close. This is the reason why an IFGA judging session lasts a few hours, while a European judging session lasts two days!

Guppies are classified first according to Caudal Standard (Triangletail, Roundtail etc.) then body color and at last the color class. This is the reason why there is a lot of individual guppy categories in European shows!

Remember that a European entry always consists of three males, unlike the American standard which has single, paired (tank) and five-fish (breeder) classes. To arrive at the point assignment for each of the judging criteria (body, dorsal, tail or vitality), the best of the trio and the worst of the trio are ignored. It is the "middle fish" who determines the score of the entry. For example, if the body length of one guppy in the trio earns 8 points, but the others earn 6 and 7, the entry is awarded 7 points for body length.

The total score for the entry assigned by each of the individual judges are tabulated (e.g.: 77, 81, 82, 84, 86). The lowest and the highest scores are discarded (now: 81, 82, 84). The average of these three scores is calculated (82.33). This is the score assigned to the entry.

There are no prizes given for guppies in individual categories. There are just too many categories. Instead, prizes are awarded to the best guppy within a caudal class.

BOS (Best of Show) is awarded to the guppy with the best overall point score (for example, 89 out of 100).

Iridophores: Metallic and Platinum Colors

Cell	Color
Iridophore	metallic or iridescent, blue, silver, white, yellow, gold, green

The metallic colors are due to a type of color cell called an iridophore. Iridophores are sandwiched between melanophores and the yellow and red pigment color cells in the skin. They reflect and scatter light. While pigment color cells produce color by the selective absorption and reflection of light, the reflective color cells produce color by scattering or interfering with light.

See the article *Guppy Color System* at the beginning of the Guppy Color Bank for the different types of color cells and their arrangement in the guppy skin.

The iridophores give this male its iridescent green color. Philip Shaddock

Here is a white guppy with a "metallic" or iridescent quality:

This is a Micariff. Micariffs are never "yellow metallic," just white metallic. Philip Shaddock

Platinum

The most common form of metallic guppies are the sex-linked "platinums."

According to guppy lore, the first "platinum" guppies arose out of the Viennese Emerald Green as a mutation. They were named Schimmelpfennig Swords, although Schimmelpfennig Lyretails might be a better term considering they have a reputation for poor swords. The Japanese use this metallic gene in a lot of their strains.

Schimmelpfennig Sword. The yellow platinum color comes from color yellow colors above silver iridophores. In the green areas of the body, blue iridophores give the color a green color (yellow + blue). See the color wheel in the Guppy Color System article.

Mutations

For a common autosomal mutation affecting the iridophores, see the Note on *Stoerzbach Metal*.

For a common sex-linked mutation affecting the iridophores, see the Note on the *Platinum* gene.

The *Green Emerald Iridescent* entry discusses a mutation common among swordtail strains.

The *Blue Diamond or Luster* entry in the Notes discusses a mutation that causes a proliferation of blue light-reflecting iridophores.

See the strain entries for *Japan Blue* and *Lazuli* for more blue iridophore mutations.

See the *Coral Red* entry in the Notes for a metallic red version.

M

Magenta General Information

History

The magenta gene was first discovered in a strain

that combines the gene with the Moscow gene, the Flamenco Dancer. It was developed by the Thailand fish farm Siam Trade Co and first made available in 2003. The strain apparently originated from a guppy imported from Romania and crossed into a local Thai strain.

Young Magenta Male by Hans-Peter Neuse

You can barely see magenta color in the caudal of this Magenta Moscow. Philip Shaddock

Description

Magenta is a gene, not a strain. It is like "albino," a modifier gene that changes the color of a strain by affecting the development or fate of one or more types of color cells. While the gene is named after the color that is emphasized by the magenta gene, it is by no means certain that a magenta guppy will be colored "magenta." This suggests that the mutation's expression is complex, affecting more than one type of color cell.

It is clear from the different ways that the magenta allele is expressed in outcrosses that it has a pleiotropic effect on guppy color. When it is incorporated into a half-black strain its magenta color is expressed fully:

This was a cross between a Magenta Moscow (Silverado) and a Full Platinum carrying the half-black allele. There was very little magenta color in the Silverado father. See the picture below. Philip Shaddock

When it is incorporated into a Moscow strain, a number of phenotypes emerge, including the Blue Silverado strain (see the Blue Silverado below).

The Moscow has a lot of black in its color, so a comparison between the half-black and the Moscow suggests that the black color cells are a factor in the expression of the magenta allele.

The Flamenco Dancer, the original guppy phenotype with the gene, is essentially a Magenta Moscow with a lot of red in the body (creating a purple color) and it has magenta red fins.

The Blue Silverado can be viewed as a Flamenco Dancer without red fins and with a blue body instead of a purple body. Strain and photo: Philip Shaddock.

This is the Flamenco Dancer phenotype imported into Europe. Photo by Franz Peter Schaffarth.

The other characteristic of the magenta gene is its tendency to affect color cells in a patchwork fashion, or a piebald effect (see the picture below).

Incorporating the allele into a snakeskin apparently produces a metallic phenotype not unlike the Silverados.

RREA Full Red Magentas by Hans-Peter Neuse

Piebald type Magenta Moscow. Philip Shaddock

The magenta allele appears to "break up" the black melanophores and other colors into a kind of "salt and pepper" pattern when it is associated with certain genes, like the Moscow gene. In another version of the Flamenco Dancer you can see this clearly (see Asian Flamenco Dancer below)

Another characteristic of guppies incorporating the magenta allele is poor fin shape.

The fact that the black color and iridophores appear to be affected adds evidence to the theory that the magenta gene may be a mutation affecting the migration and fate of black color cells.

Asian Flamenco Dancer. Photo by Philip Shaddock. This version of the Flamenco Dancer came from Singapore.

Another characteristic of guppies incorporating the magenta allele is poor fin shape.

Genetics

Through a carefully controlled crossing experiment, Philip Shaddock has confirmed the earlier finding by Claus Osche that the magenta allele is autosomal dominant.

Its peculiar pleiotropic effects on guppy color, affecting both the type and distribution of color cells has yet to be understood.

Because the Magenta allele is autosomal dominant, all that is required for its expression is a single allele. An example is a Moscow guppy heterozygous for the Magenta allele.

XY^{Mw} M/-

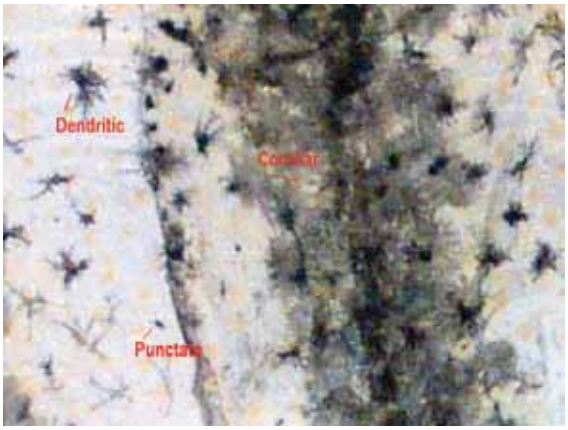
Where Mw = Moscow, M = Magenta

The forward slash and dash indicate that the phenotype will be expressed whether or not the other allele is magenta or wild-type.

Melanophores: Black Color Cells

For an overview of the way guppies and other fish, amphibians and reptiles organize and display their color cells, read the *Guppy Color System* article at the beginning of the Guppy Color Bank. This article specifically discusses the melanophores.

	Pigment Organ	Pigment	Color
Melano-phores	melano-some	melanin	black

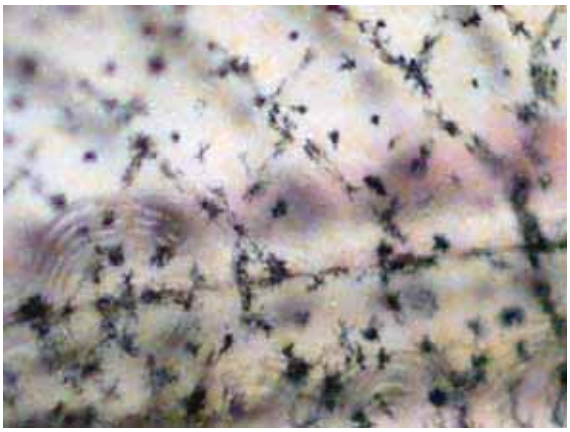


Melanophores at 200X. You can see the three basic types of black color cells. The corollar black color cells are deep in the skin, at the level of the dermis. The other cells are in the epidermis and the scales. Notice also the yellow color cells (xanthophores) that are present at birth. Philip Shaddock microscope studies.

Wild-type and newborn guppies have three main types of color cells, black melanophores, yellow xanthophores and light-reflecting iridophores. They are uniformly grey, with the exception of the half-black mutant color cells in domestic stocks. Typically the color cells form a diamond-shaped (reticulated) pattern.

Most people think of the color black on guppies as being due to a single gene or a single type of color cell. But that is very far from the truth. In their classic paper on melanophores, the black color cells, the

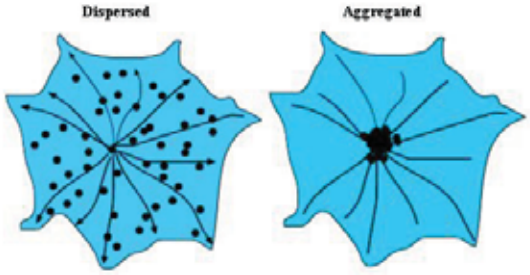
scientists Nayudu and Hunter ("Cytological Aspects and Differential Response to Melatonin of Melanophore Based Color Mutants in the Guppy, Poecilia reticulata, Copeia, 1979(2), pp. 232-242") identify four types of melanophores found in wild-type guppies. This means that there cannot be a single gene governing the development and expression of black color in guppies.



Wild-type pattern. This is a fry. Notice the diamond-shaped pattern of the melanophores. There are other melanophores scattered in between the pattern. The grey, yellow and light-reflecting colors combine to give the guppy its olive gray color. Philip Shaddock microscope studies.

Chameleon Role of Melanophores

Melanophores play a major role in guppy color changes because of their motile pigment.



Melanosomes dispersed throughout the cell and aggregated to the center of the cell.

The black pigment, encapsulated in melanosomes, can move from the center of the cell to spread out throughout the cell. This darkens the guppy. When it aggregates to the center again, the guppy becomes lighter.

Through mutation melanophores are now found all over the ornamental guppy's body and in all layers of the dermis. Scientists have a term for this: ectopic.

Mutations

The *Blond and Golden Mutations* article in Notes discusses two well-known black color mutations and discusses the modularity of black color cells in response to mutations.

The *Albino Mutation* article in Notes discusses the mutation that affects black pigment production.

Merah Fin Shape

Golden HB Yellow Merah (Tiger Yellow Tail Tuxedo Merah). Junichi Ito, Japan

Other Names

Sometimes this fin shape is called "Crown Tail" or "Crowntail."

Description

The Japanese refer to this fin mutation as "Merah." It appears to have lost tissue between the fin rays.

May, 2005 It was introduced for the first time by the "Fish magazine" of Japan.

Genetics

According to Junichi Ito, the genetics of the Merah is autosomal dominant. This means that out crossing a Merah to a non-Merah fish will show the Merah phenotype. However, Junichi says that the Merah may be incompletely dominant over the normal fin shape. He cites the example of the male HB Yellow Merah pictured above.

According to Junichi, the mutation is a form of apoptosis of the fin tissue. "Apoptosis" is a form of cell death. From Wikipedia: Apoptosis "is a process of deliberate life relinquishment by a cell in a multicellular organism. It is one of the main types of programmed cell death (PCD), and involves an orchestrated series of biochemical events leading to a characteristic cell morphology and death. The apoptotic process is executed in such a way as to safely dispose of cell corpses and fragments."

Apoptosis is a normal process of the body, however apoptosis of the cell fin tissue appears to be a genetic mutation.

Breeders Comments

Junichi Ito

The mutation can easily and quickly be incorporated into other strains because it is autosomal dominant.

Metal Guppy General Information

Full Platinum. Photo and guppy Philip Shaddock.

There are two very general classes of guppies that have mutations of the iridophores, the light-reflecting "metallic" color cells. There are metallic guppies that have sex-linked iridophore mutations, generally called Platinum, Emerald Green Iridescent, Japan Blue (Aquamarine), Lazuli or Blue Diamond (Luster) guppies. And there are autosomal recessive metallic guppies, commonly called Stoerzbach guppies.

It is very likely that there are many more mutations that cause iridophores to either be reduced in size, distribution or shape that have not yet been documented.

Common Mutations

For a common autosomal mutation affecting the iridophores, see the Note on *Stoerzbach Metal*.
For a common sex-linked mutation affecting the iridophores, see the Note on the *Platinum* gene.
The *Lazuli* strain (see the entry in the Color Bank), which has a full body lazuli metallic color is a dis-

tinct metal type. The *Green Emerald Iridescent* article in the Notes discusses a mutation common among swordtail strains. The *Blue Diamond or Luster* article in the Notes discusses a mutation that causes a proliferation of blue light-reflecting iridophores. See the strain entries for *Japan Blue* which has a blue iridophore mutations. The *Micariff* strain is metallic.

Moscow General Information

Other Common Names

Metal Heads (see below).

History

Moscows originate from the city by that name, arriving in East Germany and then spreading around the world from there.

The first Moscows to find their way to Germany looked like this.

According to a magazine article published in Russia, the Moscow guppy can be traced back to an individual at a certain time. The Moscow was invented by Mikhail V. Matasov between 1951-1952. It was developed from a laboratory strain acquired from Professor V.F. Natali, a geneticist who published articles on the guppy. Matasov was known as "Mr. Guppy." He was a very dedicated, modest and hard working breeder. The article says the Moscow is a conglomerate of at least four genes.

Most people think this solid colored Moscow is the prototypical color, but Blue Moscows were a later development. Guppy and photo: Philip Shaddock

Description

Although the original Moscows were half-body snakeskin, today the Moscow is popularly considered to be a solid-colored guppy, including a colored head. There is actually a lot of debate about what characteristics define the Moscow, while people generally recognize the strain immediately. A guppy with a black or blue head and some blue, dull metallic color in the top of the front of the body usually can be identified as belonging to a Moscow heritage. These characteristics are Y-linked, passed father to son, so Moscow males always have Moscow sons. In extensive crossing, it has been discovered that the Moscow Y-linked genes that are dominant and persist from one generation to the next is the blue head, metallic blue upper front of the body and black spotting and streaking in the fins. However these traits may be recessive to X-linked genes in some cases.

The Blue Moscow is the most common form, although the Green Moscow is also plentiful. Blue and Green Moscows are essentially the same. Green Moscows just have a lot of yellow color cells in the top layer of the skin. Purple Moscows have plentiful

red color cells. Some breeders have even developed the Red Moscow. See the entry for the *Albino Red Moscow*. In that article, there is evidence from Oscar Inostroza's cross for the full body metallic Moscow trait.

The other common characteristic of Moscows is a black component to the color. This causes variation in Moscow apparent coloring from light blue (or other pigment color) to a dark version of that color. The black component can become so dark as to produce a Black Moscow. However, true Black Moscows have been developed using half-black and three-quarter black guppies.

What sets apart "normal" Moscow black is its highly motile pigment, meaning the black pigment aggregates to the center of the cell and disperses to the cell periphery under stress or other environmental conditions. This gives the Moscow its famous chameleon quality, where it can vary from a light grey to a much darker black. Black Moscows do not tend to have this motile black color. They never lose the deep blackness of their color. What this suggests is that the chameleon Moscow black is a different mutation affecting black color cells then that found in Black Moscows, which is not chameleon.

Genetics

The colored head, front of the body and streaks and dots in the caudal are due to a Y-linked gene. Evidently the Y-linked genes form a supergene. It appears to be close to the SDR (sex determination region) because there has not been a confirmed case of a female who passes on the trait to her sons or daughters. The fact that the head and the top of the front of the body are so strongly Y-linked means that the rest of the body can be influenced by both Y-linked and X-linked genes. This is the reason why it is incorrect to say that a "Blue Moscow" is due to a single gene. Even the metal head and front of the body can come under different color gene control, producing silver headed Moscows, for example.

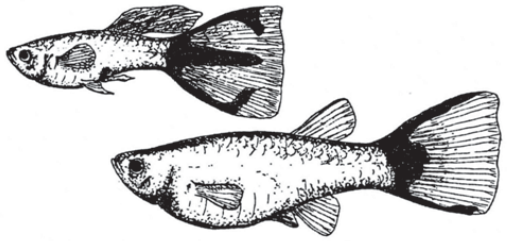
Another candidate member of the supergene is the rectangular red spot commonly found on Moscow strains. See Notes on *Red Spots*.

P

Pigmentierte caudalis (X,Y)

See the Notes section at the end of the Guppy Color Bank for a description of melanophores in the article: Melanophores: Black Color Cells.

Pigmentierte caudalis (Cp) translates to "pigmented caudal." It adds black color to the caudal fin.



It is described in the paper "Cytological Aspects and Differential Response to Melatonin of Melanophore Based Color Mutants in the Guppy, Poecilia reticulata" by P. L. Nayudu and C. R. Hunter, Copeia, 1979(2), pp. 232-242. The gene was first described by Dzwillo in 1959.

> Pigmentierte caudalis tail pattern (Cp) is composed of two morphologically distinguishable populations of melanophores. One of corollar type 90 x 90 μm is positioned along the caudal peduncle-tail fin junction and forms the central streak of the adult pattern. The other, bipolar 80 x 20 μm, occupies the dorsal and ventral edges of the fin. The melanophores are first visible at 3 weeks of age in a characteristic pattern, reminiscent of accentuated wild-type melanophores.

The authors note that the Cp pattern is inhibited during development by the half-black (NiII) melanophores. Nayudu and Hunter believe the Cp gene is actually two closely linked genes.

Genetics

The Cp gene is X- or Y-linked.

It is a well known fact that when you combine the Cp gene with the double-sword gene (or genes), you get a triangle (aka delta) tail shape. Kirpichnikov provides an illustration of the combined genes.

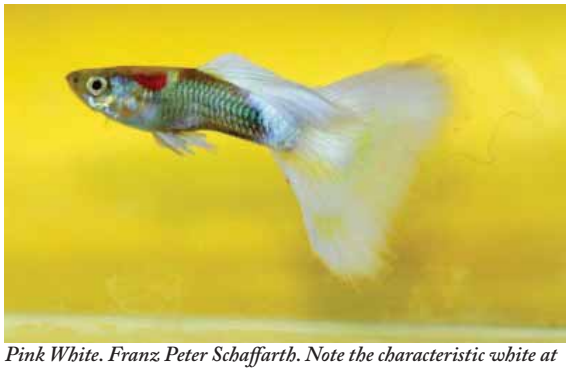
A guppy with Cp and Doublesword genes produces a delta tail

Philip Shaddock had a strain of Japan Blue guppies that were delta. When he out crossed the strain to Moscows, the strain developed poor swordtails.

Philip Shaddock strain. Notice that the caudal fin is missing color on its trailing edge. The color in the fin exactly parallels the shape of the trailing edge.

It was likely that an X-linked Cp gene had segregated out, leaving a doublesword gene on the Y-chromosome.

Pink White



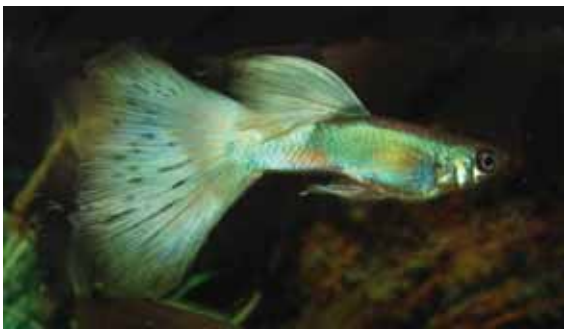
Pink White. Franz Peter Schaffarth. Note the characteristic white at the base of the peduncle and the white fins. Also notice the presence of the half-black allele.

Pink Whites have white fins and a white area at the top of the base of the peduncle. This white area is found in both males and females.

Pink Whites have been assigned to a totally different category than Pingus or Pinks. Despite the similarity in names, these are different mutations because they are found on different chromosomes. The Pink White mutation affects a gene found on the X and Y chromosomes. The Pink or Pingu mutation is found on an autosomal chromosome.

The gene is commonly said to be sex-linked (X or Y).

It is also said to require the presence of the half-black gene to express the pink color. However in a crossing experiment, Philip Shaddock discovered that the gene does not require the half-black allele to be expressed. The Moscow used in the cross does not have the half-black allele and the female F1 offspring do not show evidence of the HB allele.



Blue Moscow male X Pink White female. This is the F1 male of the cross.

Notice that the female does not show the HB trait.

The Pink White Moscow does not look like a Panda (a Pink Moscow). This is another indication of the difference between the mutations.

The Pink White allele does behave just like a sex-linked color. The color appears after birth. This distinguishes it from the Pink mutation, which affects color cells that appear at birth.

Clearly this is not a Pink guppy with a half-black allele. The conclusion from the cross must be that the Pink mutation and the Pink White mutation are different:

A guppy with the Pink White mutation has the following genotype.

$X^{(Pw)}Y$

Where Pw = dominant Pingu allele

It is not known if the Pink White allele crosses over to the Y-chromosome. It can be assumed it does.

Pintail Fin Shape

Platinum Pintail. Picture by Finn Bindeballe, at a Danish guppy show.

Other Names

Needle Tail

Description

The Pintail fin shape is an IKGH (European) standard. Ideally the base of the caudal should be round and 4/10th the length of the body. The center fin rays are extended to a fine "pin" shape. The dorsal fin is supposed to be held high, and end in a sharp point.

Genetics

The gene is generally considered to be X-linked and

dominant. It is represented by the gene symbol Pt.

Platinum

Full Platinum. Philip Shaddock

Description

The Platinum phenotype is a guppy with a shinty metallic color, usually white, yellow or green.

The difficulty comes when it is combined with other metal mutations, such as Stoerzbach metal. There is an extensive discussion of the differences in phenotype between the Full Gold and Full Platinum strains in the Full Gold entry.

The guppy pictured at the top of this article is most often called "Full Platinum" due to its solid color and metallic shine. It is almost always an albino, with many versions also carrying the blond mutation.

The female has yellow fins and shows metallic gold color in her body.

Genetics

See the *Platinum Sword* entry. It is commonly believed that the platinum gene came from the Platinum Sword (known as the Schimmelpfennig Metal Swordtail in Germany).

Female Full Platinum

It is not entirely clear how this strain differs from the Full Gold or El Dorado strains. The Full Gold strain is said to have the Stoerzbach metal allele and not the Platinum allele. The El Dorado is said to have both. An interesting experiment would be to cross a known Stoerzbach strain with a known Platinum strain to see if the El Dorado phenotype results.

Genetics

The Platinum gene can be X-linked, Y-linked or both. It easily crosses over. The Platinum gene is dominant over the wild-type allele. It's gene symbol is P:

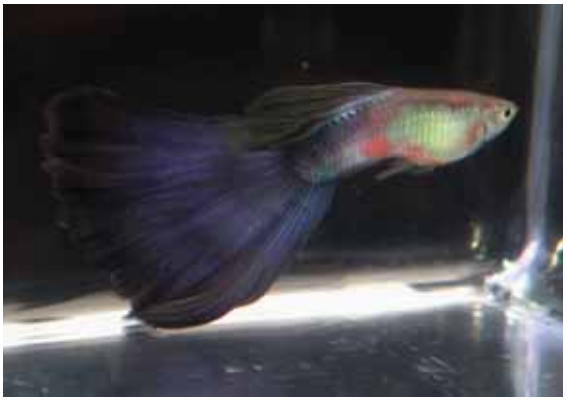
XY^P

The strain shown in the picture at the top of this article appears to have Platinum alleles on both sex chromosomes. There is also a Y-linked white platinum area in the upper part of the front of the body (which you can see in the above photo of the male). See the gold flecks of color in the above picture of the female. This is usually a telltale sign that the female is carries the platinum gene on her

X-chromosome.

R

Red Spots



IFGA Purple with a red spot. Photo by Philip Shaddock

The red spots found on many strains is interesting. They are definitely the most prominent feature of wild guppies.

Wild guppy. Collected in a ditch in Taiwan by Eddie Lee.

Red spots on guppies play an important role among wild guppies signaling the health and vitality of the male.

The genes responsible for red spots are commonly found in the SDR (sex determination region) of the Y-chromosome. (The SDR is described in the Common Genetic Terms section of the Genetics Appendix.)

Red Spots a Common Trait in Guppies

Many IFGA strains without half-black patterns, or without other patterns that affect the peduncle, have this pattern.

Genetics

Red spots are most often Y-linked and many of them are found to be *strictly* Y-linked, meaning they are in the SDR, are dominant, and rarely cross over. This makes them useful as markers in tracing guppy strain genealogy.

Ribbon or Giessen Fin Shape

This Ribbon Silverado is only 2.5 months old. Guppy and Photo: Philip Shaddock

Other Names

Giessen (Germany)

History

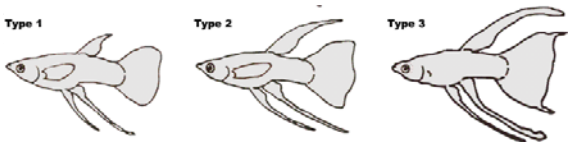
The Ribbon or Giessen is said to have been found by Dr. Förster in a pet shop in Germany. Since males with elongated gonopodiums cannot physically impregnate females, at the university where he worked (Giessen University), Dr. Förster used artificial insemination to artificially inseminate females.

Dr. Förster called the longfins Giessen after his hometown "Giessen". In an article he reported that artificial insemination of females produced a second type of long fin.

The ribbon type that originated in Singapore has been extensively bred by the Japanese.

Description

The Ribbon trait is characterized as having a shark-like dorsal, and evenly extended gonopodium and pectoral fins. The caudal is often not elongated.



As you can see from the picture, the gonopodium appears to remain steady in length. However all the other fins have three lengths, short, longer and longest. The caudal appears to be affected only in the case of the Type 3.

Genetics

The ribbon trait is determined by the "Rib" gene, which is autosomal and dominant to the wild type. Because the ribbon male's gonopodium (sex organ) is extended, it is nonfunctional for breeding. A normal, non-Ribbon male must be bred to a Ribbon female who is heterozygous for the ribbon trait (Rib/rib). This will yield both Ribbon and non-ribbon males and females at a ratio of 1:1 (50% males and 50% females will be Ribbon).

What remains to be determined is what causes the difference between the three types. Are these allelic forms of the same gene, or the result of interactions with other genes?

For comparison, see the *Swallow* fin type in the Notes section of the Color Bank.

Roundtail Fin Shape

Medusa roundtail guppy. Guppy and photo by Karen Koomans.

The short roundtail fin shape is typically complex. Roundtail guppies appear in crosses between guppies that do not appear to be roundtail. An example is a cross between Moscows and Pink (or Pingu) guppy delta strains. The fact that a short tail guppy results suggests that the roundtail shape is due to the suppression of fin length. Indeed this would support a theory that says wild guppies have regulatory factors or genes that prevent the tail from growing beyond a certain length.

Luke Roebuck has said that some of the best roundtails come from Asian farm bred lines. He believes crossing roundtails with Asian fantails produces a better shaped fin, presumably because the fantail shape increases the vertical diameter of the roundtail.

In the Breeders Comment section of the Medusa Roundtail entry, Karen Koomans has this to say about breeding roundtails:

"Shorttail guppies were born exclusively out of females that showed a transparent line under their belly and throat. Another breeder of this type of guppy, Christiane Müsch from Germany, also reports on this typical female feature (see Faszination Lebendgebärende - Hochzuchtguppy Spatenschwanz Galaxy, web site in German)."

S

Saddleback / Half-Tuxedo

Half-Tuxedo Snake Speartail. Picture by Finn Bindeballe at a Danish guppy show.

The saddleback mutation looks like the half-black pattern has stopped half-way down the body. Since the melanophores initially migrate from the dorsal neural crest early in development and a portion of them follow a path downward, this pattern may help to solve some of the mystery of the half-black pattern.

Ronan Boutot, guppy breeder and author, has a friend who speculates about the pattern. "Dr. Alain Grioche, ichthyologist, and very good friend of mine, made the following observation about this mutation. It looks like the melanophores have not migrated fully down. The pigment cells normally migrate along the metameres from the back to the stomach (belly). So we can suppose that the protein directing the cell migration does not exist in the caudal part of the mutant fishes. This might mean that one day this pattern could extend along the length of fish body : black back, white stomach (belly)."

Snakeskin General Information

Snakeskin Roundtail. This European form of the snakeskin has a short rounded caudal fin. Picture by Philip Shaddock

Common Names

In the IFGA, the snakeskin is described as "coarse patterned" or "lace" depending on overall density of the chain link pattern on the body. An old term for snakeskins with a vertical bar pattern in the peduncle (see the *Bader Snakeskin* entry) is "cobra." However it has fallen out of use as a term in the IFGA.

According to the French guppy breeder and author Ronan Boutot, the terms for this pattern in Europe are as follows:

- Cobra = big or coarse pattern
- Filigran = very thin pattern

He says the Filigran, which would be called Lace in North America, is considered to be a modification of the Cobra pattern by a gene they call lace.

In Asia, a common name for snakeskin is "Cobra."

History

There have various claims made about the origins of Snakeskin guppies. However, the filigree pattern on the body may have been developed and enhanced from tiny patterns on wild guppies that the earliest scientists attributed to what they called "filigran" genes.

Description

The snakeskin pattern consists of alternating bands of melanophores (black color cells) and iridophores (metallic or reflective color cells) with pigment color cells covering the pattern (yielding yellow, green or red snakeskins). In the modern forms it can cover almost the entire body.

IFGA HB AOC. You can barely see the snakeskin pattern n the front of the body. Notice that the snakeskin pattern in the fins has become dots. Photo by Philip Shaddock

The snakeskin pattern and half-black pattern appear to have an epistatic relationship, meaning they are mutually exclusive. When you cross a half-black guppy with a snakeskin the peduncle is black and the rest of the body is snakeskin (see the picture of the IFGA HB AOC above).

Such a guppy is called a "dragon" in Asia.

Genetics

The snakeskin gene is dominant over the wild type. It can be either X-linked or Y-linked, and crosses over easily.

There are separate genes for the snakeskin pattern in the body (Ssb) and the fins (Sst).

Hobbyists tend to sort patterns into coarse and lace. As the names suggests, the lace pattern has finer, more detailed chain-link patterns. However the distinction may be arbitrary, as it is often difficult to decide which category a particular guppy belongs to. See the Red Lace Snakeskin entry.

The Bar Gene

Bader-Style Snakeskin bred by Philip Shaddock.

The guppy pictured above has vertical lines or bars in the peduncle, a pattern due to the autosomal bar gene. The IFGA judging standard rules out the vertical pattern, requiring a chain link pattern.

The bar gene may be the same gene or an allele of the Winge Zebrinus gene. A discussion of the Bar

gene can be found in the Notes.

Variations

Because the body and fins are due to separate genes, it is possible to have guppies with snakeskin bodies and solid color or other patterned fins. What you get in crosses depends on where the snakeskin alleles are located.

Eddie Lee. Taken in Iwasaki's Guppy Shop

For example, a snakeskin with solid red fins has this genotype:

$X^{(Rdt)}Y^{(Ssb)}$ or $XY^{(Rdt)(Ssb)}$

Where Rdt = red tail; Ssb = snakeskin body

If the Snakeskin fin gene is retained on the Y-chromosome, then you would get a guppy with red fins dotted black. For example:

$X^{(Rdt)}XY^{(Ssb)(Sst)}$

Where Sst = snakeskin fins

The Platinum gene, which produces an abundance of light-reflecting metal color cells (iridophores) affects the snakeskin pattern, producing the Galaxy-type phenotype. See the Galaxy.

Bandit Markings

Many snakeskin strains appear to have black dots or markings in the front of the body. See the *Bandit Markings* article in the Notes.

Breeders Comments

Midge Hill in her breeding series (Breeding the Snakeskins, Vol. 5 p. 69 Extracts) notes that crossing snakes to other strains tends to increase spotting on the snakeskin tail, making the cleanliness of the cross strain's tail important. This happens especially in yellow and red crosses. Midge Hill says crossing snakes with yellows produces offspring with brilliant black and yellow caudals.

Noboru Iwasaki in his book *Guppies: Fancy Strains and How to Produce Them* suggests that Cobra females are mated with males of the Mosaic or Leopard strains to restore body size to females of these types. Iwasaki on breeding: "It is preferable not to use a male with pink or red coloration at the peduncle. The Cobra pattern should be clear and distinct on the peduncle and should not have the banded or zebra pattern. The Cobra pattern is dominant. Choose females with transparent, rounded tail. In the case of Cobra Mosaics, you should occasionally out cross Mosaic Cobra males with Mosaic females. The ideal King Cobra female has rounded caudal with faint ink blotches and spots." Iwasaki considers females with entirely black caudals as undesirable. Lace Cobra should have a lace pattern on the caudal. Mosaic Cobra females are almost indistinguishable from the Mosaic females.

The IFGA Half-Black AOC and the Asian Dragon Head or Leopard have Snakeskin genes. The Half-Black pattern obscures the Snakeskin pattern, leaving the Snakeskin pattern to influence the front part of the body. Snakeskins and Half-Black AOCs make good crosses. See the Half-Black AOC strain in the Library.

The female Snakeskin, when she is not harboring the Snakeskin gene, is used by breeders as a kind of "neutral" female for enhancing traits in completely

unrelated lines.

Conversely, the Y-linked male is often bred to pure solid color females generation after generation. (When the gene is carried on the X chromosome this method works in reverse.) This makes the snakeskin an excellent line for the compact fish room. You do not need to keep snakeskin females! (Or snakeskin males in the case of X-linked strains.) Some breeders consistently breed to a variety of pure strain females.

Snakeskins are used to improve the spots and variegated patterns on bi-color or multicolor strains.

Spadetail (Coffertail) Fin Shape

Spadetail guppy. Picture by Finn Bindeballe.

Description

The spadetail shape is somewhat rare. It was originally developed by the British breeder W.G. Phillips. The Spadetail was more commonly known as the "coffertail" in England. The caudal fin got its name from the fact it resembled the South Wales miner's shovel (coffer). During the second World War, Phillips disposed of excess guppies at a shop in London, where he lived. Some months later, he returned to the shop and discovered that the shopkeeper had not sold all his stock. The guppies had been allowed to breed indiscriminately. In the tank he saw some males with unusual caudal shapes. He took them home, and over the next several years, he perfected the Coffertail shape.

Genetics

The coffertail gene is sex-linked, and generally considered to be on the X-chromosome. Here is the genotype:

$X^{(Sp)}Y$

Where Sp = spadetail

Speartail Fin Shape

Description

The speartail is a very old European standard. In old times it was also called a "pointed tail." In 1963 Dr. Störzbach and G. Gödeke described "the pointed tail" as follows: "The form of the caudal resembles a tip of a spear. The length should be 1/4 of the body length. The dorsal fin ends in a point at the end of the first third of the caudal, bent upward."

History

The well-known breeder Horst Schillat entered the pointed tail for the first time at the Thüringer guppy show in 1965 (Kurt Leybe, Gotha).

Platinum Speartail. Picture by Flemming Straede.

The well-known German breeder Walter Jungmichel, Dresden, helped popularize the speartail standard in 1973 and worked intensively on improving it. After his death Dieter Grabe and Dieter Kaden Tiere took over the strain.

Dr. M. Trauzettel created a blond version of the speartail and practiced constant in-breeding to improve the strain. From this strain members of the German Club GKR (among others Bastian, Manni, and Franz Peter Schaffarh) derived their breeding stock. Members of the Danish guppy club (GCD) also derived their stock from this source.

Genetics

In an article originally published in Livebearer World, November 1986, W. Meyers profiles the spear tail as a small guppy (3/4 inch). The gene for the spear shape is on the X-chromosome. He says a lyretail (double sword) gene on the Y-chromosome, in combination with the spear tail on the X-chromosome, produces a good spear tail shape, although lower sword and top sword genes also work. Long-finned genes (like the triangle or veiltail) produce more ragged spear tails.

He chooses females with color in their fins, usually the same color as the male. Their caudals should be straight.

Meyers comments on the interactions between the sword and spear tail genes is interesting, and shows how the designers of the old strains used genetics to sculpt their tail shapes.

Franz Peter Schaffarth points to a discussion on the Arofanatics Guppy Talk forum about Meyers and speartails. The poster, Robert Gall, considers Meyer's information to be incorrect. He believes both X- and Y-linked genes play a role in shaping tail shapes like speartail and pintail. He says that the shape is mostly determined by X-linked genes, but the male's Y-linked genes also play an important part. The late breeder of swordtails, Häkan Turesson, has also put forward this theory that fins are under the influence of many genes. Robert goes on to say that this is not an easy tail shape to develop, presumably because you are juggling so many genes, and they are additive, meaning you will get intermediate results: short speartails, uneven tails and so on. He says that more than 90% of males have to be culled in a drop.

Breeders Comments

W. Meyer , in "Speartails," an online paper.

> "The combination I use in my speartail strain is X-linked spear and Y-linked lyretail. I find this works well. The lower sword, which I used for the original crossings, had the correct length for the dorsal. The speartail trait shows up in the female as colored fins, often with the same colors as the male. "

Gernot Kaden, Guppy-Aktuell website

> "The breeder W. Jungmichel from Dresden, who probably established the speartail (1973), probably introduced the Berlin guppy genetics into the strain through his crossing experiments. It is possible the genes are still in modern strains and is an inseparable part of speartail genetics. Colors in this strain can be relatively simple, and transferred from roundtail or spadetail strains. The appropriate males are bred to speartail females. "

According to Kaden, writing for his web page, the speartail shape is due to both sexes, both an X-linked gene, and perhaps several autosomal genes.

Dr. Matthias Trauzettel, From Guppybrief 3-97

> "I created the blond Speartail through constant inbreeding. My speartail trait is present in both sexes. A headache is the tendency for the fins to become irregularly elongated

like the Berlin guppy [ed. also known as the swallow tail guppy]. The autosomal dominant gene Kal causes the elongation of the fins. The inheritance pattern of speartails is also complicated by the Sup suppressor gene. [ed. This gene suppresses elongation, producing shortail guppies.) In the phenotype, the speartail shape is only expressed if the recessive Sup gene is homozygous. Males with long fins cannot copulate. Long fin females can have birthing problems."

Horst Schillat, From Guppybrief 3-97

> "After the death of Walter Jungmichel we took on his remaining blond Speartails. There were several problems associated with the inbreeding of this strain. The guppies grew ever smaller from one generation to the next and the gonopodium was deformed at an early age. Another problem is that with increasing age, the tail fin developed fin spikes."

Sources

Luke Roebuck, e-Bulletin, GuppyLabs. Dr. Matthias Trauzettel, Guppybrief 3-97. Horst Schillat, Guppybrief 3-97. W. Meyer, "Speartails" (online article). Robert Gall, GuppyLabs. Gernot Kaden, Guppy-Aktuell.

Stoerzbach Metal

Other Common Names

"Störzbach" is the German spelling.

History

The Störzbach gene was discovered in Germany. It takes its name from Dr. Otto-Michael Störzbach, the surgeon who was instrumental in defining the original judging standard for European guppies.

Störzbach Metal Guppy (Philip Shaddock)

In 1969 he presented the Störzbach Metal guppy to the world at a show in Berlin, and by the next year there were other breeders entering the guppy in shows. The Störzbach strain was not particularly popular probably because it was not well understood, and it was widely believed to be a strain with poor fin shape. In any event the strain disappeared from the show circuit and appeared to be lost. Fortunately the guppy breeder Horst Schimmelpfennig found them again among Berlin breeders.

The story goes that a breeder in the Berlin group of the DGF was disposing his stock and offered them to Berlin breeders. Mr. Schimmelpfennig went to his house and found the lost Störzbach Metal strain. This was a great surprise to Schimmelpfennig, because the breeder never showed, and had kept the strain going for years in obscurity. Realizing how close the guppy world had come to losing the mutation, Schimmelpfennig gave the strain special care. The breeding stock he had acquired from the Berlin breeder was no longer show quality.

Mr. Schimmelpfennig started out crossing them to Vienna Emerald Green lower swords to try to

restore them to show quality. It was lonely work because no other breeders were really interested in the strain because they heard it was difficult to breed. People he gave the stock to would return it.

In the late 80s Mr. Yoshiki Tsutsui visited Berlin and took some of Mr. Schimmelpfennig's stock back to Japan. It was a good thing that he did, because after a few years it was once more lost in Mr. Schimmelpfennig's fish room because of inbreeding.

Once in the hands of Japanese breeders, it became a favored gene for creating new and interesting guppy variations, particularly those that have the shiny metallic phenotype.

Description

The Störzbach strain is distinguished by a shiny, metallic bluish color, covering the whole body. (The green color shown on the guppy above is actually blue iridophore color mixed with yellow pigment color.) It covers the body with a thin, shiny coat of iridophores, versus the heavy thick coat of iridophores in the case of the platinum metal phenotypes.

Doublesword blond Störzbach. Photo by Karen Koomans. This may be a combination of Stoerzbach and the Emerald Green Iridescent gene.

Genetics

The Störzbach gene is autosomal recessive. The gene symbol is s and the genotype s/s. An old name for the Stoerzbach gene in Japan is solid.

It is very likely that there are different mutations assigned the name "Stoerzbach."

Swallow/ Berlin Fin Shape

Other Names

Berlin Guppy

Blond Full Platinum Swallow

History

The Swallow may have appeared in different places in the world as far back as the earliest domesticated strains. However it was first formally described in Germany in the late fifties. The German breeder Heinz Krüger developed it from what was described as a "spontaneous" mutation in his fish room. (However it is also possible he crossed into a strain he had acquired from a pet shop, which in turn had imported the mutation from Singapore.)

Description

As compared to the Ribbon type of elongated fins, all the fins, including pectoral and gonopodium fins, are unevenly extended. Both males and females are affected. Compare the swallow to the ribbon type:

The ribbon fin shape.

Genetics

The swallow trait is determined by the "Kal" gene, which is autosomal and recessive to the wild type. However, its genetics is complicated by the fact that the dominant Suppressor gene (Sup) is often present, suppressing the fin extensions, and making the guppy look like it has wild type fins. (This may explain why Swallow fins suddenly show up in crosses.) Because of the length of their gonopodiums, Swallow males cannot breed. Also, because the Swallow trait is recessive, only homozygous Swallow guppies who do not have the Sup gene can show the trait. Therefore only non-Swallow males can be used with Swallow females who are homozygous both for the Swallow trait and the non-Suppressor gene.

A study was made of these two genes by the author of a book on ornamental fish genetics, Johannes Horst Schröder.

> Die Vererbung von Beflossungsmerkmalen beim Berliner Guppy (Lebistes reticulatus Peters)
>
> TAG (*Theoretical and Applied Genetics*), Volume 39, Number 2 / January, 1969

- A new dominant autosomal mutation of Lebistes reticulatus is described, causing a veil-like elongation of fins and increased dichotomous branching of fin rays. The dominant gene Kal, responsible for the formation of veil-fins, can be suppressed by a non-allelic dominant factor Sup. Kal and Sup belong to two different linkage groups.
- Either Kal or Sup are linked with the dominant allele of the recessive xanthoric factor blond, because blond veil-fin guppies could not be obtained by recombination.
- Homozygosity for the recessive wildtype alleles of the gene for veil-fins and of its suppressor, (i.e. + Kal /+ Kal , + Sup /+ Sup) seems to result in postnatal lethality of the males.

Swordtail Fin Shape

Excellent example of a double sword. Picture by Finn Bindeballe.

According to the late Dr. Häkan Turesson, a swordtail breeder, it is likely there are several linked swordtail genes and they have to be homozygous (X- and Y-linked) before a good sword shape is achieved. He said the swordtail genes were recessive to the delta (triangle) shape.

The American breeder Dr. Jim Alderson also says there is more than one allele involved in the swordtail shape. He says that there needs to be sword alleles on both the X- and Y-chromosomes and concludes the reason why female swords do not show the sword shape is because they do not have the Y-chromosome. He believes that the allele suppressing color in the caudal is close to the sword allele(s), and that is why females with colorless caudals are reputed to produce males with better swords.

The putative genetics for a doublesword is as follows:

$X^{(Ds)}Y^{(Ds)}$

Where Ds = doublesword complex of genes

X

Xanthophores / Erythrophores: Yellow and Red Color Cells

For an overview of the way guppies and other fish, amphibians and reptiles organize and display their color cells, read the Guppy Color System article at the beginning of the Guppy Color Bank. This article specifically discusses the xanthophores (yellow color cells) and erythrophores (red color cells).

Yellow xanthophores and red erythrophores are sometimes called xantho-erythrophores because they share common chemical properties, spectral properties, and similar biological structures.

	Pigment Organ	Pigment
Erythrophores	pterinosomes / carotenoid vesicles	drosopterin/ carotenoids
Xanthophores	pterinosomes / carotenoid vesicles	sepiapterin / carote-noids

Currently it is thought that all the color cells were formed through gene duplications. It is likely that the xanthophores and erythrophores share a common lineage and share a common precursor.

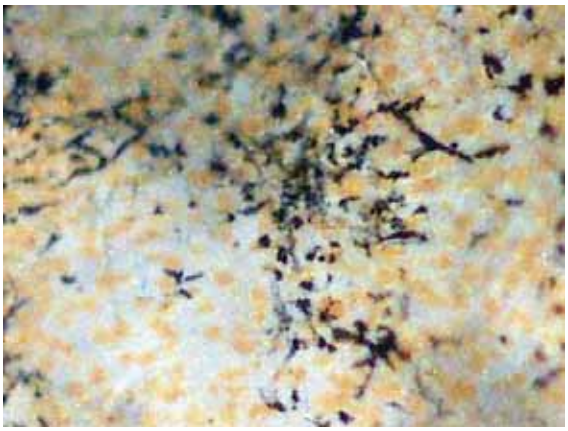
Pigment

There are actually two different types of xanthophore pigments and two different types of erythrophore pigments, carotenoids and pteridenies (drosopterin and drosopterin). What is notable about carotenoids is that they cannot be manufactured de novo in the bodies of guppies, the precursors necessary to making carotenoids have to be ingested in foods. That is one reason why red and yellow guppies have more intense color when they eat brine shrimp. The other reason is the health benefits to the guppies of eating foods containing carotenoids results in healthier and brighter fish. In fact, female guppies in the wild judge the health and vitality of potential mates on the intensity of the red spots on males. However other studies have shown that the other type of pigment, the pteridines, which the guppy can make de novo, plays an important role in guppy sexual display.

No Full Yellows

Although there are guppies that are Full Red (see the Full Red article in the Notes), there has never been a Full Yellow. The closest breeders have got is a metallic yellow guppy, like the Full Gold. However, in a way all guppies are born full yellow, since wild-type guppies are a mixture of black and yellow

color cells. Here is a 200X microscope view of grey guppy skin.



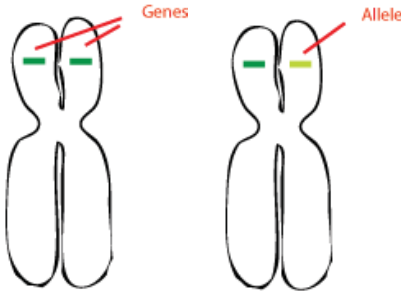
A mix of black and yellow color cells at 200x. Philip Shaddock

One of the differences between red and yellow color cells is that red erythrophores are not present at birth, unlike the yellow xanthophores. The red color cells develop some weeks after birth.

5 Genetics Appendix: Common Genetic Terms

Allele

Genes are located on chromosomes. Chromosomes come in pairs. Genes that are at the same location on paired chromosomes are called alleles. (Sort of like calling them cousins.)



Alleles are variations of genes. Since a gene is located at a specific location on a specific strand of DNA, an allele is some change in the DNA sequence at that point in the strand. Sometimes the change in the DNA sequence in a gene causes no visible change in the guppy. Such an allele is often called "silent." However, most of the time there is a change in the appearance of the guppy. For example, a fault in the gene for black color in the guppy causes albinism. (The guppy shows no black color in the body or eyes.) Accordingly, people talk of the "albino allele." The normal gene is often called the "grey" or "wild" allele.

Genes are made up of long sequences of genetic code, so you can have faults in different areas of the gene or different faluts in the same area. This will produce multiple alleles, some of which will be silent or indistinguishable from other alleles.

These multiple alleles are carried by all the guppies in all the tanks in the world. The term "genetic diversity" refers to the diversity of alleles in a given guppy population, or among all the guppies in the world. However an individual guppy can only have two genes, because genes are located on chromosomes, and chromosomes only come in pairs.

Autosomal Dominant

The term "autosomal dominant" describes a pattern of inheritance where the first generation of an out cross between a normal guppy and a mutant guppy produces all mutant offspring.

Autosomal refers to the fact the gene is inherited from a non-sex chromosome. (It's a reference to the location of the gene.) *Dominant* means the gene for the trait is expressed at the expense of the normal gene. The term *dominant* comes from the language of Mendel's laws describing the dominant / recessive relationship between pairs of genes. Since guppies have pairs of chromosomes, they have pairs of genes. If one gene of a pair (an allele) is expressed at the expense of the other, it is said to be dominant. The other allele is said to be recessive.

There are not many autosomal dominant genes, as the usual situation is that a mutation is not viable. An example is the Asian Blau mutation, where red on a guppy becomes metallic blue, is often described as autosomal recessive. But the fact is that only one blau allele is required to produce the blue metallic trait. Other examples of autosomal dominant genes include the Magenta gene and the Wingean Zebrinus gene.

Gene Symbol

Autosomal dominant alleles are usually indicated in this fashion (using the Magenta allele as an example):

M/-

The first letter of the gene name is capitalized to indicate it is dominant. It is followed by a forward slash (/) which indicates the allele is paired. The dash (-) indicates that it is dominant over the wild type so it does not matter if the second allele is the dominant mutant type or the wild-type. For example, when the Magenta gene is heterozygous, the guppy will show the Magenta trait or traits.

The Asian Blau Mutation is another example of an autosomal dominant type. See the entry for Asian Blau Mutation under the Notes section at the end of the Guppy Color Bank.

For comparison, please see the article *Autosomal Recessive* in this Appendix.

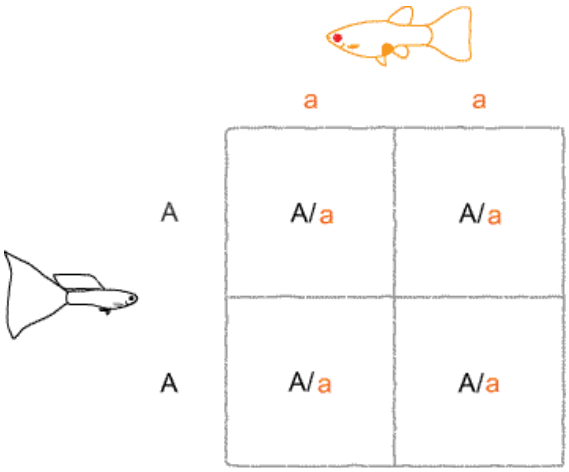
Autosomal Recessive

The term "autosomal recessive" describes a pattern of inheritance where the offspring inherit the same gene from the mother and father.

Autosomal refers to the fact the gene is inherited from a non-sex chromosome. (It's a reference to the location of the gene.) **Recessive** means the mutant gene is not expressed when paired with the dominant gene. The term "recessive" comes from the language of Mendel's laws describing the dominant / recessive relationship between pairs of genes. Since guppies have pairs of chromosomes, they have pairs of genes. If one gene of a pair (an allele) is expressed at the expense of the other, it is said to be dominant. The other allele is said to be recessive. This is why the albino trait is said to be recessive to the grey trait.

An example is the albino trait, which causes a loss of black color in the guppy. An albino is said to be autosomal recessive to the wild type or grey guppy. This means that if you cross an albino with a normal grey guppy, you will get all grey offspring.

Here is a Punnett Square that shows what happens when a normal grey guppy male is crossed with an albino female.



All the fry from this cross will be grey because grey is dominant over albino.

To see an example of how to use a Punnett Square to predict the result of crosses, see the *Punnett Square* article in Appendix.

Gene Symbol

Autosomal recessive genotypes are usually indicated in this fashion (using the Asian Blau allele as an example):

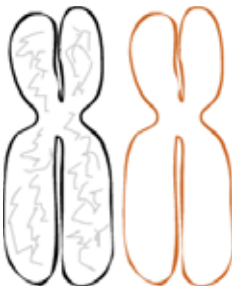
a/a

The first letter of the gene name is lower case, indicating the gene is recessive. It is followed by a forward slash (/) which indicates the allele is paired. The mutation symbol is then repeated, since the gene is recessive, and requires two recessive alleles for the trait to show. For example, when the albino allele is homozygous, the guppy will show the albino color (no black) rather than the wild-type color (grey).

See *Autosomal Dominant* under the Common Genetic Terms section of the Genetics Appendixes for a comparison.

Crossover

Crossover refers to the break-up and re-assembly of chromosomes. This allows nature to shuffle the genetic deck. It breaks the linkage between genes occupying the same chromosome. (See the *Gene and Sex Linkage* term defined in this Appendix.) Here are two chromosomes crossing over:



Before crossover

During crossover

Crossover occurs during the production of eggs and sperm. The chromosomes literally cross over each other. The chromosomes break apart and reassemble, exchanging one, sometimes two or three different segments.

After crossover

Crossover ensures that linked genes are broken apart so that they can segregate and be passed on independently. Without crossover chromosomes would accumulate errors (mutations). This would lead to the degeneration of the chromosome. By shuffling the deck, new gene combinations can be created, ensuring variation in populations of organisms.

There is at least one region on the Y-chromosome that does not cross over. See the *SDR* article in the Appendix.

Gene and Sex Linkage

Genes exist on chromosomes. Guppies have 23 pairs of chromosomes. Nobody knows for sure, but there is probably around 20,000 genes (give or take a few thousand) spread among the 23 sets of chromosomes.

All the genes on a chromosome are inherited as a unit. A gene for a long dorsal may be on the same chromosome as the gene for a snakeskin pattern.

The pair of genes on the same chromosome can be

represented graphically as follows:

A chromosome pair and two genes on each chromosome of the pair.

Illustrated are two genes (red and gray), each on a pair of chromosomes. Because they are on the same chromosome, they are said to be linked.

Linked genes do not segregate. (See *Segregation* in the Appendix.) This means that each guppy in the next generation will inherit *both traits*, not just one. An example is a short dorsal and the snakeskin fin pattern. Snakeskins long had a reputation for short dorsals. That is because the fin gene and the snakeskin pattern gene were on the same chromosome. Another example is the snakeskin body gene (Ssb) and the snakeskin fin gene (Sst). They are found on the same chromosome, so they tend to be inherited together. The closer the genes are together, the more "tightly" they are linked.

Crossover

The genes are not necessarily permanently linked. They can become divorced. In a process called crossover, which occurs during meiosis (during production of sperm and eggs) chromosomes can break apart and reassemble. This breaks the linkage between genes, causing them to literally cross over to the opposite chromosome of a pair. However, the smaller the physical distance between genes, the more infrequent they cross over. To fully understand the crossover mechanism, see *Crossover* term in the Appendix.

Sex Linkage

Sex linkage means that the gene is located on either the X chromosome or the Y chromosome. The concept is based on the fact there are two chromosomes in the guppy called the X and Y chromosomes, the sex chromosomes. Male guppies have an X and Y chromosome (XY) and female guppies have two X chromosomes (XX).

This means that only males have the Y chromosome (XY). The color and fin shape genes on the Y chromosome can only be passed on to sons. Traits under the influence of genes on the Y chromosome are said to be sex-linked.

The red gene is dominant over the grey wild-type gene. The guppy is said to be Y -linked for red.

Female guppies have two X chromosomes, one of which is probably turned off. (This is not known for sure, but it is very likely.) In wild guppies most Y-linked color genes were found to be dominant over their X-linked allele. But modern domesticated guppies do have many X-linked alleles that are dominant over their Y-linked alleles. Traits that are influenced by genes on the X chromosome are also called sex-linked. In other words, sex-linked means the trait (like the red spots on many IFGA and Moscow strains) is under the influence of a gene on a sex chromosome.

Strictly or Absolutely Y-Linked

Strictly speaking, the terms "X-linked" and "Y-linked" should be reserved for genes that do not cross over from X to Y chromosomes. So far, no absolutely or strictly linked X-linked genes have been found on the guppy, suggesting all the genes found on the X-chromosome do cross over. However there has been genes on the Y-chromosome that do not cross over.

It's important to realize that when we talk about "X-linked traits," we mean traits influenced by X-chromosome genes. However these genes may cross over to the Y-chromosome and become "Y-linked," so the designation is somewhat loose and inaccurate. When we speak of *strictly* or *absolutely* Y-linked genes, we mean those genes that *never* cross over.

Sex Limited

Sex-linked means something different than sex-limited. Sex-limited means a trait is only expressed in one of the sexes. For example, most male secondary color traits are sex-limited, meaning only males show them. The male hormone testosterone signals the develop of secondary sex characteristics like long flowing fins and bright color patterns on the body.

Punnett Square

A Punnett Square is used to diagram the possible relationships between paired genes. (See the *Allele* article in the Appendix for the concept of a paired gene.)

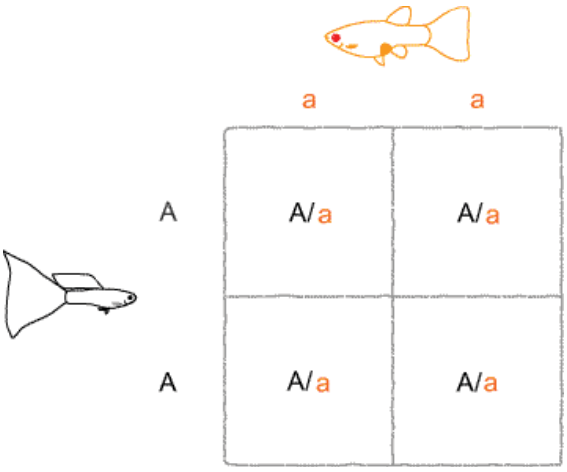
We will use the pattern of inheritance for an autosomal recessive trait as an example of how to use a

Punnett Square. We will show how the autosomal recessive albino allele and its wild-type dominant allele are inherited.

See the entry in the Common Genetic Terms section of the Genetics Appendix for a definition of *Autosomal Recessive*.

The albino guppy is missing black color and is predominantly yellow with red eyes.

Let's see what happens when you cross a purebreeding grey guppy (A/A) with a purebeeding albino guppy (a/a).



An albino female is out crossed to a grey male. The fry are all grey.

The entire drop will be wild-type grey guppies because all the offspring have at least one dominant grey allele.

Now let's see what happens when you cross a female guppy with two albino alleles (indicated with the small case letter a in yellow), with a male who has one recessive allele and one dominant A allele (indicated by a capitalized A in black).

The cross yielded 50% of males and females that were albino colored and 50% males and females that are normal wild grey.

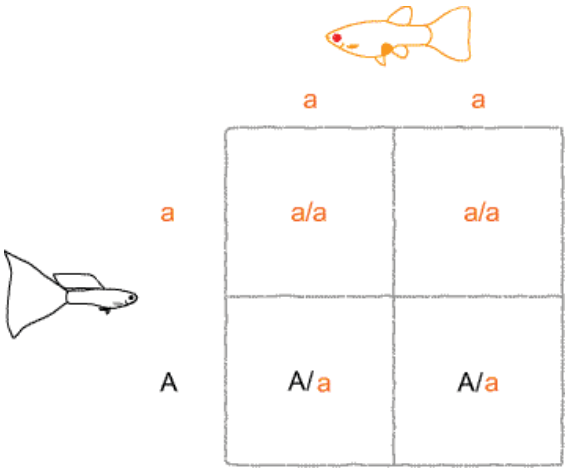


Illustration by Philip Shaddock. The paired alleles a/a means the recessive albino trait will be expressed. The paired alleles A/a means all the fry with this combination will be grey. The guppy still carries the gene for albino, but it is dominated by the normal type gene.

Segregation

When guppy breeders talk about genes "segregating," they are usually talking about the results of a second generation cross. For example, a Black Moscow was crossed with a Red Albino. In the first generation of the cross the males and females looked substantially similar, sharing characteristics of both parents or a combination thereof. But in the second generation of the cross a number of different variants occurred, a mixture of traits from the original parents.

Segregation is a concept that derives from the work of the 19th Century Monk and geneticist, Mendel. One of the general principles of inheritance he established was that genes are inherited independently and will combine and recombine in novel ways. This is often called Mendel's First Law, and it has four aspects:

1. Genes have variations. This is the concept of alleles. There are a number of different variations in the color of the base layer in guppies, including normal grey, albino, golden and blond, among others. It is the same gene, but with variants called alleles.
2. Since chromosomes come in pairs, and chromosomes contain genes, genes come in pairs. A guppy inherits one chromosome from the father and one from the mother.
3. If an individual inherits two different alleles, one allele will be dominant over the other. A grey allele is dominant over an albino allele, so the albino allele will not be expressed in the first generation of a cross between an albino guppy and a grey guppy. Eventually it was discovered that this rule was not universal. There are cases where both alleles are expressed or partially expressed.
4. When sexual reproduction occurs, the alleles randomly combine. In the case of the purebreeding grey guppy crossed with a purebreeding albino guppy, the combination in the second generation of the cross include:
   - two grey alleles
   - two albino alleles
   - one grey and one albino allele

   This produces two different variations or phenotypes:
   - two grey alleles = **pure grey guppy**
   - two albino alleles = **albino guppy**
   - one grey and one albino allele = **hybrid grey guppy**

Even though the pure grey and hybrid grey guppies look alike, they have different genotypes (different alleles).

You can see the power of segregation when you add a third trait to the mix. Let's say that the grey parent had a long dorsal fin whereas the albino parent had a short dorsal. (And the long dorsal is dominant.) In the second generation of the cross you would have:

- pure grey + pure long dorsal
- pure grey + hybrid long dorsal
- pure grey + short dorsal
- hybrid grey + pure long dorsal
- hybrid grey + hybrid long dorsal
- hybrid grey + short dorsal
- albino + pure long dorsal
- albino + hybrid long dorsal
- albino + short dorsal

There are nine different combinations! This is exactly what is meant by the "trait segregated out" in the subsequent generations.

There are exceptions. For example, if two traits are on the same chromosome, they cannot segregate, because genes are inherited on chromosomes, and it is the chromosomes that segregate. However chromosomes do break apart and recombine, so there is a rare exception to the exception.

Sex Determination Region (SDR)

The SDR (sex-determination region) is a segment of the Y-chromosome that contains a gene or several genes that determine the sex of the developing guppy. Here is a graphic depicting the sex chromosomes (X and Y). The sex-determination region is indicated in red.

In fact guppy researchers as early as Winge have suggested that there may be more genes involved in sex determination than those found in the SDR.

An important feature of the SDR area of the chromosome is that the SDR gene or genes do not crossover. (See *Crossover* in the Appendix.)

Crossover and the SDR

The SDR region is very important in guppy studies because certain genes determining secondary sexual traits like color are found within the region. For example, guppy patterns like Maculatus do not cross over--at least very, very infrequently. The researcher Haskins reported that it only crossed over once in over six decades of laboratory breeding. The Moscow supergene very likely in the SDR. There have been no verified occurrences of an X-linked Moscow.

See the Genetics Appendixes definition of Supergene under the Common Genetic Terms section.

V. S. Kirpichnikov, writing in 1981 (*Genetic Bases of Fish Selection*), says that 19 genes had been found in laboratory studies to be strongly linked to the Y-chromosome. So 19 patterns found in laboratory guppies are exclusively passed on from sons and fathers and since they do not cross over, they never pass from mothers to sons and daughters.

See the *Red Spots* article in the Notes section for an example of a tightly linked supergenes found in the SDR.

Supergene

A group of neighboring genes on the same chromosome that are inherited as a unit is called a supergene. In guppies the classical "absolutely" or "strictly" Y-linked genes are Wingean patterns (such as those in Ö. Winge's "THE LOCATION OF EIGHTEEN GENES IN LEBISTES RETICULATUS" Journal of Genetics, 18, 1927 paper).

This illustration shows a supergene (colored bars) associated with an area of the Y-chromosome in the guppy called the SDR (in red) or sex determination region.

One of the defining characteristics of a supergene is that it does not cross over, which many studies of the spotted patterns on guppies, largely black and red, have shown to be the case. The important point to remember about supergenes is that they are multigenic (due to multiple genes) color or pattern traits that appear to act like a single gene and are usually Y-linked, meaning they are exclusively passed on between father and son.

6 Genetics Appendix: Gene Table

	Symbol	Location	Reference
Sex-Linked Body Colors			
Bcp (Black Caudal and Peduncle)	Bcp	XY	Half-Black or Ni in Notes section.
Blue Diamond or Luster	Bd	XY	Blue Diamond or Luster in Notes section.
Coral Red (Neon in Europe)	Co	Y	Coral Red in the Notes section.
Emerald Green Iridescent	SmIr	Y	Emerald Green Iridescent in Notes section.
Japan Blue (Aquamarine in Asia)	A	XY	Japan Blue strain entry.
Moscow	Mw	Y	Moscow General Information in Notes.
Half-Black (Nigrocaudatus Ni)	Ni or NiII	XY	Half-Black or Ni in Notes section.
Pink White	Pw	XY	Pink White in Notes section.
Platinum	P	XY	Platinum in Notes section.
Snakeskin body	Ssb	XY	Snakeskin General Information in Notes.
Autosomal Body Colors			
Albino (RREA - Real Red Eye Albino)	a	autosomal	Albino in Notes section.
Bar	bar	autosomal	Bar and Zebrinus Genes in the Notes section.
Asian Blau	Nb	autosomal	Asian Blau Mutation in the Notes section.
Blond (Gold in the U.S. and Asia)	b	autosomal	Blond and Golden Mutations in the Notes.
Golden (Gold Europe, Bronze U.S., Tiger Asia)	g	autosomal	Blond and Golden Mutations in the Notes.
Magenta	M	autosomal	Magenta in the Notes section.
Midnight Black	mid	autosomal	Midnight Black Moscow strain entry.
Pink / Pingu	pk	autosomal	Pink or Pingu strain entry.
Störzbach Metal	s	autosomal	Stoerzbach Metal in Notes.
Zebrinus	Ze	autosomal	Bar and Zebrinus Genes in the Notes section.
Fin Shape			
Elongated Dorsal or Hi-Fin	Eld	autosomal	Elongated Dorsal (Hi-Fin) in Notes.
Fantail	Fa	X	Fantail Fin Shape in Notes.

Pintail / Needletail	Pt	X	Pintail Fin Shape in Notes.
Ribbon / Giessen	Rib	autosomal	Ribbon or Giessen in Notes.
Roundtail	Rndt	XY	Roundtail Fin Shape in Notes.
Spadetail	Spt	XY	Spadetail Fin Shape in Notes.
Speartail	Sp	X	Speartail Fin Shape in Notes.
Suppressor	Sup	autosomal	Swallow Fin Shape in Notes.
Swallow	kal	autosomal	Swallow Fin Shape in Notes.
Double Sword	Ds	XY	Swordtail Fin Shape in Notes.
Fin Color and Pattern			
Black Tail	Bt	XY	IFGA Half-Black Black strain entry.
Blue Tail	Blt	XY	IFGA Blue strain entry.
Flavus	Fla	XY	Flavus in Notes.
Grass	Gra	XY	Grass General Information in Notes.
Green Tail	Grt	XY	IFGA Green strain entry.
Mosaic	Mo	XY	Mosaic Red Tail strain entry.
Pigmentierte caudalis (Cp)	Cp	XY	Pigmentierte caudalis in Notes.
Red Tail	Rdt	XY	Red Tail Japan Blue strain entry.
Snakeskin Tail Pattern	Sst	XY	Snakeskin Pattern in Notes.
White Tail	Wt	XY	White HB Female strain entry.
Yellow Tail	Yt	XY	IFGA Half-Black Yellow strain entry.

7 Genetics Appendix: Guppy Dictionary

A

Abstract Gene

A gene associated with a visible trait. An example is a snakeskin gene. See Physical Gene.

Albinism (Albino)

A guppy with a mutation that causes it to fail to show black color cells. There are two basic forms. In one form there is a total lack of black pigment, often called RREA (Real Red Eye Albino). In the second form, a little pigment is produced. It is sometimes called WREA (Wine Red Eye Albino) or ruby-eye or lutino. The guppies have slightly darker eyes and some pale greyness in the body. It appears that human OCA1 and OCA2 alleles are homologs to RREA and WREA forms of albinism in the guppy.

Allele

Alternate version of a gene. New versions are created through mutations.

Allele Frequency

The proportion of a particular allele among all the copies of the gene in a population of guppies. Homozygotes are counted as 2 and heterozygotes as 1.

Apoptosis

Programmed cell death. The merah guppy with its missing fin tissue is said to be an example of apoptosis.

B

Back cross

Breeding daughter to father, or son to mother. Or breeding the offspring of a cross back to the original strain.

Biosynthesis

The process in cells where a chemical compound is manufactured. Pigments are the result of biosynthesis.

Blond

Scientific name for a recessive mutation affecting the black color cells. Also called Gold (U.S. and Asia). A type of black color cell mutation that causes them to lack visibility to the naked eye. The guppy looks like an albino with black eyes. See Golden.

Bronze

Name given to the golden mutation in the IFGA. See *Golden.*

C

Caudal

Abstract Gene A gene associated with a visible trait. An example is a snakeskin gene. See Physical Gene.

Chromosome

Genes are located on cellular structures called

chromosomes. Guppies and humans have 23 pairs of chromosomes.

Co-dominant

A relationship between a gene and its allele in which neither is dominant. The offspring show traits of both parents. See Incomplete Dominance.

D

Dominant

Dominance means that a gene or a trait is expressed at the expense of another. On the molecular level, the dominant allele is expressed while the recessive allele is not. On the phenotypical level, one trait is expressed at the expense of another trait. See *Recessive*.

Dorsal

Top part of the guppy. The dorsal fin is on top of the guppy.

Drop

A single spawn of guppies. The female is said to "drop" her fry during birthing.

E

Erythrophore

Red color cell.

Expression

Gene expression refers to the products (usually proteins) made by a gene. For example, black pigment is an expression of several genes.

F

Filigran

Another word for the snakeskin pattern on the guppy.

F1, F2, F3 ...

The "F" stands for "filial." It is used to denote the generation of a cross, as in "first filial generation" or F1.

G

Gene

A gene is a segment of a DNA molecule that provides the genetic code for functional RNA and proteins. Proteins are the building blocks of the body and function in cellular processes. See *Abstract Gene* and *Physical Gene*.

Genetic Drift

A change in allele frequency for a trait in a population. (See the definition for allele frequency.) Through chance or selective pressure, the allele frequencies for all the traits of an individual change from one generation to the next. Selective breeding results in genetic drift.

Gene Pool

All the genes held by all the individuals in a species in a given environment at a given time.

Genome

The sum total of the genetic code on the chromosomes of a living thing.

Genotype

The actual genetic make-up of a guppy, rather than its visual phenotype. A hybrid guppy often only expresses the dominant gene of a pair. See *Phenotype*.

Golden

Also called Gold (Europe), Bronze (U.S.) or Tiger (Asia). This is a type of black color cell mutation that exaggerates the normal diamond-shaped reticulation pattern in guppies.

Grey Allele

See *wildtype*.

H

Heterozygous

Paired genes that are different (alleles). Hybrid guppies are heterozygous for the trait under examination.

Homologous

Paired chromosomes or genes at the same locus. Alleles are genes at the same locus on paired chromosomes.

Homozygous

Paired alleles that are the same and at the same locus on paired chromosomes.

I

Incomplete Dominance

A trait that is neither dominant or recessive over another, but produces an intermediate expression.

L

Leucophore

White color cells. They are dull. They are often covered with red or yellow color cells.

Line breeding

A form of selective inbreeding where two or more versions of a strain are maintained and crossed after two or three generations.

Linkage

Genes occupying the same chromosome are said to be *linked*. "Tight" linkage describes genes located close together, making them less likely to crossover.

Locus

Where a gene is located on a chromosome. It's "address." The plural is loci.

Lutino

An albino capable of showing a little black color. See *RREA* and *WREA*.

M

Masked Gene or Trait

A gene whose expression is altered or hidden by another, unrelated gene.

Modifier Gene

Sometimes called Regulatory Gene. A gene closely associated with another gene, modifying its expression.

Multigenic

A trait under the control of more than one gene. Size is an example, since it depends on the growth in length of different parts of the body and on such factors as the strain's ability to metabolize food.

0

Out Cross

Breeding two guppies that are distantly related or not related at all. Usually refers to crosses to other strains. That strain can be the same color (i.e. unrelated strains of Half-Black Pastels).

P

Peduncle

The area from the back of the dorsal fin to the caudal (tail fin).

Phenotype

The expression of genes as a visible trait on a guppy. Expression of a gene can be influenced by other genes (epistasis), or controlled by regulatory genes, or influenced by the environment. So the phenotype and the genotype often differ dramatically. See *Genotype*.

Physical Gene

A physical gene is an actual segment of DNA with a beginning and an end. An abstract gene is a gene composed of two or more physical genes on separate segments of DNA. See Abstract Gene.

Pleiotrophic

The expression of a gene in several different traits. For example, both the size and color of a guppy is affected by the albino gene.

Pteridine

The chemical compounds making up the yellow and red pigments.

R

Recessive

A gene or trait that is not expressed because of the presence of dominant genes. For example, a guppy hybrid with one albino gene and one normal gene is normal colored (grey). It is said to be recessive to the dominant wildtype allele. See *Dominant*.

Reciprocal Cross

Mating the male of one strain to the female of the other and vice versa.

Regulatory Gene

A gene which controls the protein-synthesizing activity of other genes. See Structural Gene.

RREA

Real **R**ed **E**yed **A**lbino. See the *Albino* entry.

Ruby-Eye

A type of albino that manufactures a small amount of black pigment. See the *Albino* entry.

S

Strain

The word strain is applied to guppies that usually breed true over several generations (80% of the males are 80% similar to their fathers.) **T**

Tiger

The name given to the golden mutation. See *Golden*.

Tightly linked

Genes on the same chromosome that are very close to each other such that they crossover very infrequently. See *Crossover*.

Triple Recessive

A guppy with three recessive mutations. The term is also used as a strain description.

Tuxedo

Name given to the half-black phenotype in Asia. The guppy appears to be wearing a black tuxedo.

W

Wildtype

The normally functioning version of a gene. A guppy exhibiting a "normal" phenotype. Another name is the "grey" version, named after the grey base color of wild guppies.

WREA

Wine **R**ed **E**ye **A**lbino. See the *Albino* entry.