Inside the Treasure Chest

Components of Silver and Gold

By ELISE SCAFANI
Jade River

My first exposure to coat color genetics began in 1995, when I developed an interest in breeding and showing rabbits. I did not immediately grasp all the concepts involved in understanding color genetics. Much like a favorite childhood pastime, jigsaw puzzles, I assembled these ideas one by one.

I first developed a working knowledge of the basic principles of genetics, and then was able to build on that knowledge until I could accurately understand the relationship between what I saw in the coat color and the genes responsible for that appearance. If you have difficulty grasping these concepts at first, be patient, with some determination you can build your own understanding one gene at a time.

The field of genetics is quite vast with relatively few genes having been accurately identified and mapped. Conclusive coat color genetics research has been done in various species with respect to many of the primary genes that govern color expression.

Many of the "known" genes are essentially monogenetic in nature meaning, a single gene is responsible for a particular trait.

CH Jade River's Tourmaline,
Shaded silver Exotic female
Light shaded silver coloration

GC Wyndcreste Liaison, *shaded silver Persian female*
heavily shaded silver coloration

Examples include:

* The coat color pattern - agouti vs. non-agouti (tabby vs. solid).
* The foundation colors – black, chocolate and red.
* The intensity of color expression - full color vs. dilute (black, chocolate, red vs. blue, lilac, cream).

These basic traits are further influenced by groups of genes or polygenes also referred to as modifiers. For the most part, these polygenes have not been firmly identified or located on the feline genome.

In the absence of information that has been scientifically proven, we have information that is the product of experience and hypothesis. We do have names that refer to the action of some of the more commonly accepted groups of polygenes.

Examples include:

* Wide banding or Wide band effect
* Rufousing or Rufous modifiers

It is in the "land of the polygene," that the art of selective breeding takes a most interesting turn.

Let's start at the beginning with brown tabby which is the color most dominant, or "wild type" in cats. Wild brown tabby has a generally cool appearance. Each hair has the typical agouti banding with both black and yellow color bands along the length of the hair. While there are some "yellow" layers in the coat, the overall appearance is not warm like the Golden but cool, seemingly more black than brown. Through generations of selective breeding the appearance of brown tabby has diversified, staying cool in some cases and warming considerably in others.

Silver and golden are genetically very similar to brown tabby. Both silver and golden are a semblance of the primary color genes expressed: agouti, black, and intensive.

Silver is brown tabby wearing an invisibility cloak we call the inhibitor gene. Unlike Harry Potter's invisibility cloak, this cloak is selective, only able to cover the yellow pigment (phaomelanin) in the hair shaft while the black pigment (melanin) remains visible.

When the first Silvers appeared they were much darker than those in exhibition today. I say "appeared" because like any new genetic mutation, the first of its kind seems to "appear" as if by magic. For example, the dwarfing gene responsible for the short legged Munchkin or the curly gene that is the foundation of the Selkirk Rex. These genes and the traits they govern first appeared by spontaneous mutation and were then selected for a specific breeding purpose.

The first Silvers had significantly heavier tipping and bands of grey color in their undercoats. Through selection for clear undercoats and minimal tipping the Silver has evolved to have a widened intermediary band. The intermediary band is the portion of the hair shaft where black pigment is absent and typically, the yellow pigment is visible.

By widening or elongating the intermediary band, the portions of the hair shaft capable of expressing black pigment have been minimized, thus clearing the undercoat and lessening the tipping. Under this mysterious yellow cloaking device – "inhibitor," all Silvers are actually Brown Tabbies.

By selecting the silver offspring with the clearest undercoats and least amount of tipping, we also select for the inhibitor gene and accompanying genetic factors that are the strongest. Although the inhibitor gene is believed to be completely dominant, I believe there are many modifying factors that are its support staff.

Occasionally we see what we refer to as "tarnish" on a silver coat. For years I was told and believed this meant that the cat was heterozygous for inhibitor and that the tarnish was a glimpse of the golden that the cat carried. Through test breeding we have shown that not all tarnished cats carry gold, and not all tarnished cats will produce tarnished offspring nor will all golden cats produce tarnished Silvers.

The inhibitor gene has a difficult job and in order to be completely successful it must be at its best, all its ducks in a row, so to speak. I believe that when we see tarnish it is because the inhibitor's support staff is on holiday, one or more ducks are off splashing in the wrong pool.

It is not a simple on/off issue but one of baby steps. In order to eliminate the tarnish we need to select away from it. It may be that a tarnished cat bred to a cat with exceptionally strong inhibitor factors will produce non-tarnished offspring. Or we might attempt to clear a tarnished line for several generations with little success.

When working with Silvers there are many minor factors hidden from view which adds a degree of difficulty when selecting for certain traits. If we could visualize all of Silver's hidden color traits, it would

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CH Salon De Chat Queen-of-Hearts
Chinchilla golden Persian female
Highly rufoused "hot" golden coloration

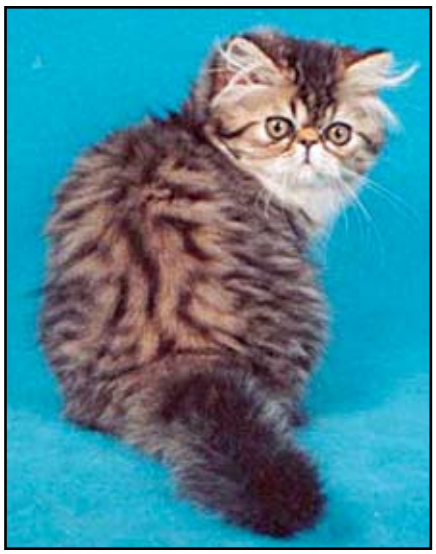
Jade River's Shimmering Light
Shaded golden Exotic female
Mildly rufoused "cool to medium" golden coloration

Glossary of basic terms

Expression – The physical manifestation of genetic information.
Genotype – The genetic code responsible for a trait.
Phenotype – The physical appearance of a trait.
Locus – A place on the genome where a specific gene or genes are located.
Order of dominance – The order in which several possible genes at any one locus are responsible for the expression of a trait.
Dominant gene – the gene that will determine a trait when paired with any other gene at that locus.
Completely dominant gene – a gene that determines a specific trait and is not affected by other genes present.
Incompletely dominant gene – a gene that shares the responsibility of determining a trait with other genes.
Recessive gene – a gene that will determine a trait only in the absence of other genes higher in the order of dominance.
Carry – refers to a recessive gene that is possessed but is hidden by a dominant gene at the same locus.
Homozygous – both genes at a particular locus are the same.
Heterozygous – the two genes at a particular locus are different.
Modifier – a gene or group of genes that alter the expression of other genes.
Melanin – the chemical responsible for dark or black pigment.
Phaeomelanin – the chemical responsible for yellow pigment.
Wide banding – describes the elongation of the intermediate color band on the hair shaft.
Rufous modifier – describes the factor responsible for the "redness" of a coat color.
Wild type – the expression of the most dominant genes as seen in nature.

simplify the process of pairing cats to produce a particular result or eliminate a certain fault.

The Golden has no cloak to hide under and all its color traits are just hanging out there for the whole world to see. Golden has reaped the rewards of countless generations of selection intended to "clear" the silver coat.



Fluffygrape kitten,
Medium warm brown tabby coloration

When the inhibitor cloak is removed from the Silver we are left with brown tabby once again. The difference now is that unlike the cool wild brown tabby coloration, the Golden has a widened intermediary band and is able to display more yellow pigmentation making it a much warmer color overall.

You may be wondering why some goldens are on the yellow end of the color spectrum and others are closer to red. The most simplified answer is rufous modifiers. "Rufous" is not a big dog that eats your couch thus modifying the appearance of your living room. "Rufous" is the name given to a group of polygenes that work together to turn up the heat and warm the appearance of the intermediary band.

Rufous modifiers actually amplify the yellow pigment. Some Goldens have very few of them while others are really loaded. Rufous modifiers have a cumulative effect. As is the case with many polygenes, they are not merely turned on or off, but are accumulated through generations of selection to produce a stronger and stronger effect.

I hope this article has helped, or with repeat readings, will help the reader gain a better understanding of the genetic factors responsible for the Silvers and Goldens we all admire so much.

Fluffygrape Diva,
cool brown tabby coloration