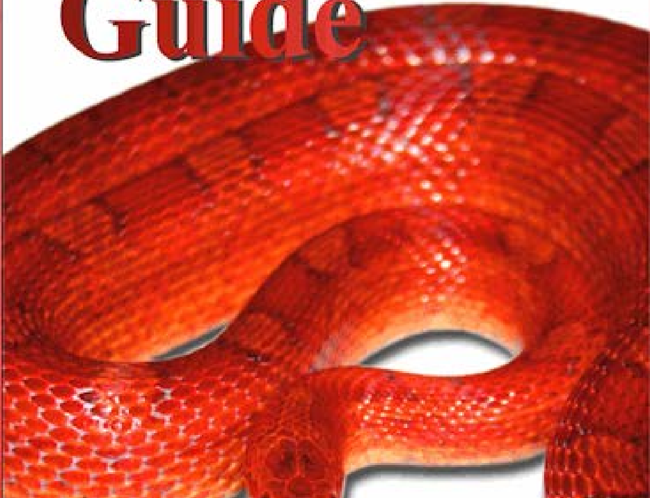
DIGITAL

Cornsna
Morph
Guide



A Collector's, Breeder's, and Buyer's Guide to Morphology, Genetics, Pricing, & Identification

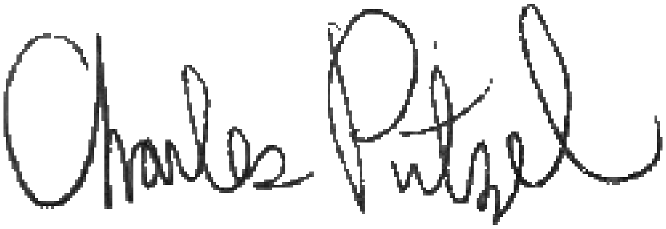
Charles Pritzel

2009 Edition

Important Notice:

This book is the result of a lot of hard work. It took a lot of time and resources to research and gather existing knowledge, experiment and discover new knowledge, and finally to organize all of it into a useful format. If you wish to say thanks by leaving me a donation, you can send money via paypal to serpwidgets@hotmail.com, amazon (or other retail) gift card, or bitcoin using the QR code, or email me at serpwidgets@hotmail.com to see what other options might be available.

Thanks, and enjoy!
Charles Pritzel



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2009 CMG

Foreword

This guide is intended to act as a starting point and a reference, as opposed to an all-encompassing knowledgebase. Once you have a grasp of genetics and a feel for the various general classes of morphs, the best way to become familiar with the specific looks of the morphs and *all* their variations is to see as many examples of each of them as possible. Internet forums have a lot of pictures, and breeders' websites are another good resource. If you can attend reptile shows, browsing all of the tables and talking to the breeders is another good way to gain additional experience.

Since the "language" of the cornsnake hobby consists almost entirely of slang, you will undoubtedly hear differing usages of the terms in this guide. You'll also hear words that do not appear in this guide at all. The author will attempt to keep up with any common usages within the mainstream of the hobby, and a new edition will be published each year.

This year more test breedings involving the "stargazer" and "short tail" genes are planned. The purpose of including these is not to present them as legitimate morphs, but to inform readers about any known genes that can affect their breeding results, good or bad.

Given the rising numbers of double and triple genetic morphs, a new chapter on breeding schemes was added in 2008 and is being retained this year. The method presents one way of easily rolling over these double and triple combinations into quadruple and quintuple combinations.

In previous editions there was a section about projects and experiments being conducted by fellow hobbyists. That section has returned this year, with the hope that a few hobbyists will pick up some of these projects themselves. It is also hoped that hobbyists will help flesh out the data for the hypermacro project and participate in making the method useful for present and future hobbyists.

Normal Cornsnakes

In order to understand what variations there are, it is necessary to be familiar with the normal appearance of cornsnakes, including natural variations on the theme.

A normal cornsnake pattern is composed of three color groups:

- Melanin – **Mel**-uh-nin, describes the browns and blacks.
- Erythrin – **Air**-uh-thrin, describes the reds and oranges.
- Xanthin – **Zan**-thin, describes the dark yellows which are presumed to be carotenoids collected from the snake's diet.

- The dorsal pattern consists of red saddles.
- The saddles are outlined in black.
- The ground color is anywhere from light gray to tan to orange.
- Starting from the edge of the belly to varying points on the side, there are generally one or two rows of side blotches.
- Often the blotches on the side are connected to either the dorsal saddles, or the lower blotches.
- Yellow pigment often grows in during the first year or two after hatching. It will be most visible on the sides of the jaw and neck.
- Two longitudinal stripes, generally a gray or "dirty" color, can appear along the length of the snake, at about the ten o'clock and two o'clock positions on the back.
- Two additional dark longitudinal stripes can appear, one along the middle of each side.
- The belly is similar to a basic black and white checkerboard pattern. Some color, usually red or a light red/tan, can wash over the white parts of the belly.
- A "blush" in the cheek area. This is from blood supply instead of a pigment, and thus it is present in all cornsnakes.

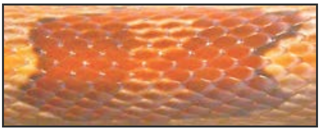
Hatchlings will start out with very little of the red, yellow, and orange coloration. To many beginners, hatchlings look like anerythristics or some “odd morph.” The saddles will be a deep burgundy or brown, and the ground color is in shades of gray or tan, with orange “dots” of color visible between the saddles, especially on the neck. The colors generally reach their peak when the snake is about 3 feet long.

There are many variations on this basic “normal” theme, all of which are still considered normal. They include, but are not necessarily limited to:

- Longer, shorter, wider, or thinner saddles.
- Fading out of two areas inside the saddles, one on either side.
- Fading out of a large area in the middle of the saddles.
- A few saddles being offset or smashed together, forming a **U** or **S** or **Z** or **W** shape.
- Thicker or thinner borders around the saddles. (Thinner borders can be gray instead of black.)
- White stippling around the outside of the black borders.
- Absent or more prominent “dark” longitudinal striping. This can also turn a light gray in adult cornsnakes.
- A great deal of variation of “general darkness” in the overall colors of the snake can be found among normals.
- Some belly checkers missing or bunched up.
- Belly checkers fading to brown, light tan, or reddish tan.
- A “stripe” of white running down the center of the belly.
- Freckling or a red wash across the belly, especially near the tail.
- Slight blurring/smudging of the lateral pattern, compared to the dorsal pattern.

The following are just a few examples of the wide variation to be found in normal cornsnakes.

White Stippling around saddles



Two saddles almost joined

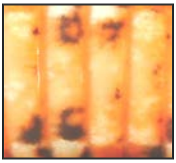
Offset or joined saddles

Some breeders select away from the white stippling around the saddles, as opposed to breeding for it.

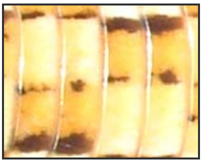
Dark longitudinal striping is especially more apparent during shed cycles

Faded areas on sides of saddles

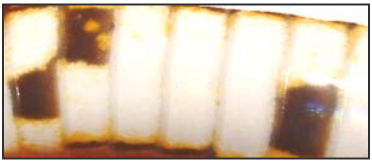
Note that many breeders select away from the dark striping and dirty overwash of melanin, so this look is slowly becoming less common in the general population.



Belly with clear center



Faded Belly checkers

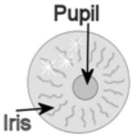


Missing belly checkers

Keep in mind that the same amount of variation is possible in each of the color and pattern morphs, too.

Additionally, males and females in many lines exhibit *dimorphism*, where the males are an overall lighter color, have more of a general wash of oranges/pinks, have thinner border areas, and are more prone to the “white stripe” on the belly where the checkers do not meet. These differences are usually more obvious in anerythristics and lavenders, and many bloodreds, but can also be observed in normals and virtually every color/pattern morph.

Eye Colors



The eye color consists of the iris color and the pupil color. The iris color is determined by the same pigments that form the skin colors. Iris color tends to match that of the saddles, but in some specimens it can tend toward, or even match, the ground color.


Normal


Normal

These two normals demonstrate saddle-colored versus ground-colored eyes. There could be a single gene controlling this aspect of corn eyes, but none has been isolated yet.


Amel


Snow

Both amels and snows have red/pink pupils. The snow also has cataracts, which may be common in older snakes.


Cinder


Anery


Charcoal


Hypo Pewter


Lavender

The brown/gray morphs have a wide variety of eye colors ranging from light tan to dark brown and black. With reduced melanin the color does not become light gray. Instead it becomes hazel and then blue, just like human eyes. Hypo pewters and lavenders are two of the morphs which can have ruby pupils and blue eyes.

If red or yellow pigments are present, the eyes will usually take on that coloration as the pigments grow in. In normal specimens the eyes will start out reddish-brown and then slowly turn to orange/red as the snake grows up. If only melanins are present in the iris, the color scale goes from black where the most pigment is present, and turns to brown, tan/silver, and then blue when very little melanin is present. Morphs where blue eyes have been observed include ghosts, phantoms, lavenders, hypo pewters, and neonate ultramels.

The “ghosted” group (any of the 30+ combinations of anery-like and hypo-like genes) holds the greatest potential for extremes in eye coloration.


Honey


Ghost


Phantom


Hypo Lav

The pupil color is controlled by melanin content in the retina. Generally the pupils are black, but when melanin becomes scarce enough, the blood supply present in the retina will cause the pupils to become a ruby color. In some lines of hypo and ghost corns this occurs often. Lavenders, and especially ultramel corns and hypo lavenders will typically have ruby pupils. The few known hypo pewters also have ruby pupils.

There is no dividing line where pupils suddenly cease to be black and become ruby or pink. It is a sliding scale like the difference between hot and cold. Some snakes will appear to have ruby pupils only some of the time, depending on the lighting each time you observe them.


Ultramel


Lava

The ruby eye in lavas and ultramels is most intense when they are hatchlings. As they mature they tend to gain pigmentation. The ruby eyes become darker in adults. This ultramel’s pupil is just barely ruby. The lava specimen has darkened enough that its pupils appear normal.

In other species there are certain genes known to control pupil color independently of skin color, but no such genes have been demonstrated in corns to date. A “ruby-eyed” and/or “pink-eyed” gene that controls the eyes independently from the skin color could someday be located. Until such a gene is proven out, it is assumed that some hypos and ghosts which exhibit ruby eyes result from having slightly less retinal melanin than their black-eyed counterparts.

Head Patterns

There is a great deal of variety in the head patterns of cornsnakes. Although this is generally not considered a major part of cornsnake patterns, colors, or genetics, these variations can be fascinating on their own. Some of the variants appear to be inherited like simple genetic traits.

It is hoped that the American Cornsnake Registry will be an extremely useful tool in studying head patterns, and trying to determine their modes of inheritance.

- The basic arrowhead blotch is a "key." The key can be modified in several different ways.

- The lines that connect the different parts (top, middle, bottom) can be broken on one or both sides.

"Tulip" patterns (left) can be formed by a missing center. "Smiley" and "deadbolt" patterns (right) can result from breaks between the middle and the top.

- The top, center, or bottom of the blotch can be enlarged. This "crowning" tends to create points along the edges of the blotch.

Many "club" type patterns come from enlargement of the whole blotch. Notice the crowning points on each.

- The top, center, or bottom of the head blotch can be connected to the outside of the head pattern. This can come in the form of a complete connection, or just a tendency in that direction.

The "ringneck" (found in a lot of striped corns) connects to the outsides along the back end of the blotch. Connections can be made from the middle of the key, the upper sides, or the top.

This example shows five common places where the central blotch connects to the outside:
1- Top center.

2 & 3 – left and right upper connectors, in this example connected on the left side.

4 & 5- left and right middle connectors, in this example extended on the right.

Between these five, and the two where the "ringneck" is formed, there are a total of seven main connecting positions.

- In more extreme examples, often found on corns expressing the diffused or masque patterns, a shape like a skull is apparent. It is often called a “scream” pattern because it resembles the white mask in the “scream” movies. Generally, the top point is connected, along with two pairs of points from the upper side, and the center. These leave only two oval-shaped spots.

(Left) Skull patterns on “pewter” and “bloodred” specimens.

(Right) Incomplete connection of the center can leave a heart shape.

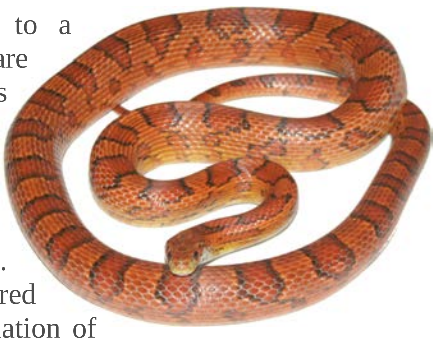
Some head patterns are not as easy to classify. The first and second examples below (“twig and berries”) look to have a key with a broken center. The other two below, like the head patterns of many sunkissed corns, seem to defy the usual descriptions.

Some head patterns appear to be more common in certain morph types. This may or may not be a good indicator of the ancestry of a cornsnake, so in most cases it’s not a good idea to use it as a method of identification. So far, very little work has been done on the inheritance of head patterns.

Selectively Bred Variations

Note that only the most common selectively-bred morphs are covered here. It is possible to select for any particular set of characteristics and many breeders have their own distinct lines. Just because a morph is not covered here does not mean it has not been honed by a breeder to bring out certain traits.

Okeetee (Okeetee Phase) ($30-$70)
Pronounced “Oak-uh-tee.” There are two main uses of this word:



The original meaning refers to a locality, and some people are interested specifically in corns from this locality. The stereotypical Okeetee corn has extremely bright orange and red colors separated by thick, bold black borders. Okeetees are generally considered the most attractive natural variation of cornsnake, but not all specimens from this area match the description. They are also referred to as *Hunt Club Corns* or *True Okeetees*, in an effort to distinguish them from the second type. The Registry may help track lineage of these animals to retain locality information.

Another meaning has branched off from this, and is perhaps more common than the original. It refers to corns having the stereotypical “look” of Okeetee locality corns. Many of these have been produced from various bloodlines. They will have some, little, or no connection to any corns from the actual locality. They are also sometimes referred to as “look-eetees” or “Okeetee Phase” in an effort to ensure the buyer doesn’t assume they are locality corns. Cornsnakes cannot be het for Okeetee or Okeetee Phase.

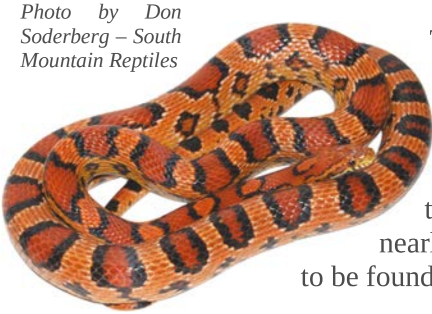
Sub-varieties of Okeetees:

Many breeders have a special admiration for Okeetee corns and have been breeding them to improve upon the wild-type Okeetee look. The two most well known are Kathy Love's Okeetees, and Lee Abbott's Okeetees.

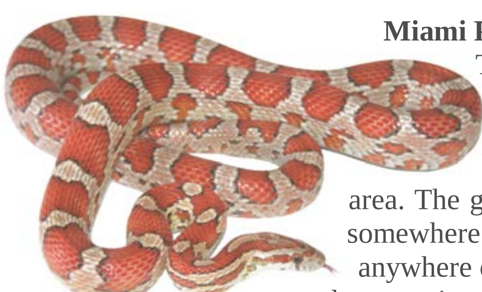
Photo by Bill & Kathy Love – Cornutopia.com

The **Love's Okeetees** tend to stand out from wild-type Okeetees in several ways. Kathy has succeeded in breeding out the dark longitudinal striping. The "holes" inside the saddles have been removed so that the saddles are one solid color, and the white stippling around the saddle borders is absent or reduced. The other distinctive quality of Love's Okeetees is that each color on the snake is extremely smooth, instead of being speckled.

Photo by Don Soderberg – South Mountain Reptiles



The **Abbott's Okeetees** are most well known for the extreme thickness of the black bordering. In some examples, the saddles near the tail end of the snake are solid black or nearly so, with little or no red color to be found inside the borders.



Miami Phase ($25-$40)

The name “Miami phase” was coined to describe a look that is often found in corns coming from that area. The ground color is gray, tan, or somewhere between. Cornsnakes from anywhere can take on this look, so the name does not imply a locality, nor does any corn coming from that area automatically qualify as a “Miami phase.” Hatchlings have a clean gray ground color. Individuals with the least traces of orange on the neck tend to generally turn out with the cleanest gray ground colors as adults. Cornsnakes cannot be het for Miami phase.

Upper Keys corn, Keys corn, Rosy Ratsnake ($30-$50)

Cornsnakes from the Florida Keys used to be classified as a separate subspecies. They tend toward an overall lighter appearance, similar to hypos. The belly checkering is generally not as strong, or is even absent. The ground color tends more toward shades of tan, and there is generally less contrast between ground and saddle colors. The black borders around the saddles are less prominent than in typical corns, or entirely absent. Cornsnakes cannot be het for "upper keys" or "rosy ratsnake."

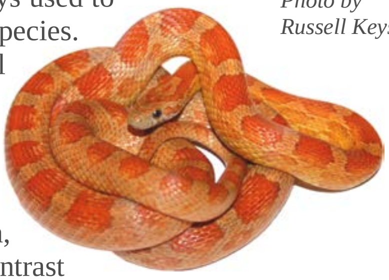


Photo by Russell Keys

Kisatchie, *Slowinskii* ($40-$60)
These come from certain areas of Louisiana and Texas, and are thought by many to be an intergrade of cornsnakes and emoryi ratsnakes. The new classification, which separates Elaphe into Pantherophis, considers them a separate species: *Pantherophis slowinskii*. Colors are in dark browns and grays and can look somewhat like very dark anerythristics. Cornsnakes cannot be het for Kisatchie.

Photo by Don Soderberg – South Mountain Reptiles

Milksnake Phase, Banded ($40-80)
Banded cornsnakes have been bred to have wide saddles, or saddles which connect to the side blotches for a banded look.

The milksnake phase lines are intended to resemble eastern milksnakes. They were started with Miami corns, and as a result tend to have a light/clean ground color. Milksnake phase corns have also been crossed into motley lines. Carol Huddleston is investigating to see if they are in any way related to sunkissed motleys, since some of these retain checkering combined with a motley-like appearance.

Cornsnakes cannot be het for milksnake phase, or banded.

Aztec, **Zigzag** ($40-$70)

Partial zigzag pattern

The zigzag pattern results from the left and right sides of the saddles being offset from each other, creating a "zipper" type of pattern. This can occur on anywhere from a single saddle to all saddles. Generally a snake is not considered a zigzag unless 80% or more of the saddles are zigzagged. Specimens with less are often called "partial zigzag" or "partial aztec" instead.

Aztec pattern

Aztec is an aberrant pattern that often has small pieces of colors strewn about, as if the saddles were made of glass and had been shattered. As with zigzags, a little, some, or all of the pattern may be affected, and individuals with a large amount of the aberrant aztec pattern are valued.

Some individuals will show both zigzag and aztec type patterning. Individual cornsnakes can show varying degrees of either of these patterns, and both types can mix and meld between one and the other, so there is plenty of gray area between what is considered zigzag and what is considered aztec.

Selective breeding of the most extremely patterned individuals generally creates the most extremely patterned offspring. These are very unpredictable patterns. Sometimes crosses – even between parents with the best patterns – produce normally patterned offspring. In other cases, normally patterned parents can produce extremely odd patterned offspring.

Cornsnakes with aztec or zigzag parents are commonly listed as “het” for zigzag or aztec. Do not assume they will produce these patterns in the same way as proven genetic traits do.

Other variations…

Many breeders selectively breed to establish certain looks in their own lines. When they are satisfied that a line is sufficiently different to warrant a name, they will apply one.

On the other hand, some breeders or resellers will simply apply a name in order to try to sell their product more easily, because it implies that the snakes are “special.”

Do not assume that a cornsnake with an unrecognized name is automatically special, but don’t assume it is a scam either. If you think they would be a good addition to a breeding project, ask the breeder some questions, such as:

- What is special about the individuals with that name?
- How were they produced?
- Are there any known genetic traits involved?
- Do they “breed true?” (If I breed two of these together, will the offspring look like these?)
- Are there any other unusual or notable tendencies (good or bad) in that line?

Someone who has worked hard on a project will have a lot to say about them. Someone who has simply attached a name in order to sell something will not have much to say.

Either way, that type of corn still may be a good addition to your projects, but it’s helpful to have as much information as possible about what you are working with.

Genetic Morphs

To understand all of the genetic traits involved in corn morphs, it is vital to know how *all* types of traits work, instead of memorizing results of crosses involving recessive genes. Genetics For Herpers is highly recommended reading for anyone wishing to learn how it all works.

Morphs are organized by locus, with selectively-bred and genetic combination morphs appearing in those sections.

Readers unfamiliar with the terms *locus* and *allele* need to familiarize themselves with these concepts in order to work with genetic cornsnake morphs. Many hobbyists continue to practice and teach pseudogenetics, especially in other species. Any explanation of genetics that does not include these terms is insufficient to deal with the reality of cornsnake traits as they are known today.

Example pictures should not be used as an absolute standard or identification method. Some traits will mimic each other -- such as charcoal and anery, and ultra and hypo -- so a visual identification may be insufficient. Just because your snake looks more like the ultra picture than the hypo picture, does not mean your snake is an ultra. When the specific gene is unknown, breeding trials or other identification methods are necessary to find which gene is involved.

Common Names - While all genetic combination morphs can be identified by a listing of the genetic components, a few morphs are sometimes called by a more fanciful name. These common names or "trade names" are not intended to be an exact description or color swatch of the morph, but to present a more "artistic" version. Some are more commonly applied than others.

Snow – amel, anery
Blizzard – amel, charcoal
Butter – amel, caramel
Opal – amel, lavender
Ghost – hypo, anery
Phantom – hypo, charcoal
Amber – hypo, caramel
Topaz – lava, caramel
Platinum – hypo, charcoal, anery
Orchid – sunkissed, lavender
Pewter –charcoal, diffusion
Ice – lava, anery
Granite – anery, diffusion
Golddust – ultra/ultramel, caramel
Fire – amel, diffusion
Avalanche – anery, amel, diffusion
Whiteout – charcoal, amel, diffusion
Sulfur – caramel, amel, diffusion
Plasma – diffusion, lavender

The Albino locus:

Allele	Name
A^+	Wild Type
a^a	Amelanism
a^u	Ultra

Genotype	Known as:
$A^+ \cdot A^+$	Wild type
$A^+ \cdot a^a$	Wild type (Het Amel)
$A^+ \cdot a^u$	Wild type (Het Ultra)
$a^a \cdot a^a$	Amelanistic
$a^a \cdot a^u$	Ultramel (single-heterozygous for Ultra/Amel)
$a^u \cdot a^u$	Ultra

Amel, aka **Amelanistic**, **Albino**, **Red Albino**. ($20-$40)

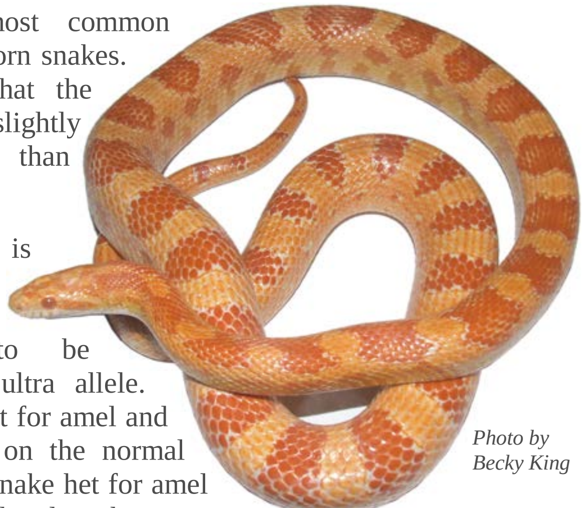


Photo by Becky King

Amel is the most common mutant found in corn snakes. It is estimated that the amel allele is slightly more common than wild-type.

The amel gene is recessive to the wild-type allele, and appears to be recessive to the ultra allele. That is, a snake het for amel and normal will take on the normal phenotype, and a snake het for amel and ultra takes on the ultra phenotype.

As its name suggests, when amelanism is expressed, melanin (the black/brown/gray pigment) is absent. Areas where black would normally appear will instead be white, yellow, pink, or even "greenish" looking. Some amels hatch out with little to no color and nearly resemble snows. So far, specimens hatching like this have turned into typical-looking amels within a few sheds.

Amels are most easily identified by their eyes. The eyes are a distinctive glowing red/pink, except for a small dark spot toward the front of the eye. If the pattern of the snake is one where belly checkers are expected, the "black" areas on the belly should instead be a clearish flesh color, or a shade of yellow/orange/red.

Selectively-bred variations of Amel:

Sunglow, "No-white Amel" ($40-60)

The idea is to remove all traces of white, and to get a bright orange ground color. This creates a very bright red and orange cornsnake.

Photo by Bill & Kathy Love – Cornutopia.com

Some breeders use hypomelanistic corns as a starting point, since many hypos have thinner borders. The motley pattern (used to create sunglow motleys) also tends to reduce the border thickness and get rid of a lot, or all, of the white. The diffused and striped patterns have also been used to augment the sunglow look. Some sunglow offspring will start out with white borders, which will then fade out as they mature. Amelanistic cornsnakes cannot be het for this look.

Candycane ($50-70)

The idea is to remove the oranges and yellows from the ground color, leaving red saddles on a clean white background with striking contrast.

Photo by Russell Keys

Any ground color is undesirable in this morph, so they tend to resemble an amel version of the silvery Miami phase normals. Candycanes are often divided into two types, red and orange. The red or orange refers to the saddle color, and **not** the ground color. A "candycane with orange ground color" would be a regular amel.

Since the yellow and orange ground color grows in as cornsnakes mature, some clean-looking candycane hatchlings can grow up to look less than ideal. It is not possible to predict with 100% accuracy which ones will do this as they grow up. But as a general rule, the hatchlings with the least amount of yellow or orange ground color, especially on the neck, will tend to grow into more ideal candycane adults. An amelanistic cornsnake cannot be het for candycane.

Reverse Okeetee, Amelanistic Okeetee, Albino Okeetee ($40-75)

The use of the name "Okeetee" with this morph does not imply the Okeetee *locality*, just a look. A stereotypical Okeetee corn has bold borders on bright colors. The amelanistic version still has the bright orange ground color and red saddles, but the wide black borders have been "reversed" to white. These are often bred mainly for the thickest possible white borders, with the ground color being secondary in importance. No cornsnake can be het for Okeetee, and likewise, amelanistic cornsnakes cannot be het for reverse Okeetee.

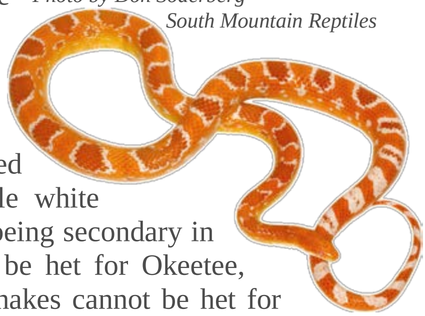


Photo by Don Soderberg – South Mountain Reptiles

Genetic Combinations with Amel:

Amel + Hypo – ($40-60) Hypo's effect on the coloration appears to be masked by the amel trait. Since hypo also has a mild effect on the patterning, it may affect amels, but to date nobody has presented a reliable way to visibly separate these from regular amels.


Photo by Becky King

Amel + Sunkissed – ($???) Sunkissed Amels have so far displayed the expected combination of the sunkissed pattern drawn in the colors of an amel. However, only a small number of specimens exist at this time.

Photo by Russell Keys

Amel + Lava – ($???) "Lavamels" appear to be a brightened version of amels with more of the saturated reds/oranges. It is unclear at this point how much of the difference is caused by the lava gene versus selective breeding.

Amel + Anery – ($25-50) ***Snow*** is one of the most common double morphs. As hatchlings, saddles are pink on a white background. If saddle borders are present, they will appear "clear" and can develop yellow or mild "green" colors. As they mature, the saddle colors can fade in contrast, or turn a more pastel orange-like color. Between these and the yellows and pinks and "green" hues, snow corns can be very colorful. (*See* "Pink & Green" *and* "Coral" *snows, Page 38*)

Amel + Charcoal – ($50-80) ***Blizzard*** corns are similar to snows, but generally have a less noticeable pattern and nowhere near as much color. The saddles are a pinkish white. Hatchlings and some adults can appear virtually patternless. Yellow rings sometimes grow in around the saddles.

Amel + Caramel – ($35-70) As hatchlings, ***butter*** corns can somewhat resemble snows or amels. Butters can range in appearance from almost "snow-like" to almost "amel-like." Saddle colors tend to range from yellow to a dark brownish orange, and the ground color ranges from white or off-white to shades of yellow.

Photo by Sean Niland – VMS Professional Herpetoculture

Amel + Lavender – ($60-100) ***Opal*** corns somewhat resemble snow and blizzard corns. In some, the ground colors are more colorful than the saddles, which can be almost white, and they look like a snow corn with the colors reversed. Others can be as low contrast as blizzards. As with other lavenders, a wash of orange/pink can be present, especially in juveniles.

Photo by Sean Niland – VMS Professional Herpetoculture

Amel + Diffused – ($100-$150) ***Fire*** corns are gaining in popularity for those who enjoy bright amelanistic corns. Several breeders are working to improve "sunglow" corns by adding bloodred lineage into the morph. Some grow up to have very little or no white flecks.

Photo by Caroline Piquette –Breeding Colors

Amel + Motley – ($25-50) Many of these tend to be very bright amelanistics, and are also known as "*sunglow motley*" when the ground color is a bright orange and white is absent. Candycane motleys are being bred but are less common than sunglows.

Amel + Striped – ($50-65) Like amel motleys, striped amels tend to be very bright in coloration. A line of sunglow stripes also exists. Candycane stripes are still unknown at this time.

Photo by Kat Hall – Corn Quest

Amel + Cinder – ($???) Carol Huddleston hatched out this combination in 2005. This morph should give a good indication of how much red is to be expected in corns expressing the cinder trait.

Photo by Carol Huddleston –Low Belly Reptiles

Ultra and **Ultramel** *(short for "Ultra/Amel")* ($50-90)

Ultra is the next mutant allele to be discovered at the amel locus.

Ultras are the most extreme-looking hypo-like corns to be discovered so far. Ruby-red eyes are often apparent in ultras, and some can almost be confused with amelanistic corns. Some hatchlings also have blue or green irises. There is currently some debate concerning whether amel is codominant to ultra, or recessive to it. In other words, it is currently unproven whether there is a difference in the phenotypes of ultras and ultramels. This book treats them as a single phenotype for simplicity's sake.

As adults, ultras and ultramels can become darker. The accumulation of pigment with age can also reduce or remove any ruby glow from the eyes in adults.

It should also be noted that some ultramels may be darker than some ultras, and some ultras/ultramels may resemble standard hypos, so determining genotypes visually may be less than 100% accurate. The new 'hyper macro' method of morph identification might help with these cases.

The origin of the ultra gene was under some scrutiny and many suspected it originated in gray rat snakes, or "white oaks phase" gray rat snakes. The hypothesis was tested last year by Russell Keys, who showed that a white oaks gray rat snake was not carrying the ultra gene.

Since ultra and amel are alleles, and amel is widespread in the gene pool, ultramels are quickly being produced in combination with the other mutant genes.

Genetic Combinations with Ultra/Ultramel:

Ultra/Ultramel + Hypo – ($???) Currently unknown.

Ultra/Ultramel + Sunkissed– ($???) It appears that this combination will resemble an ultramel in coloration, with the sunkissed pattern. Only a handful of these currently exist.

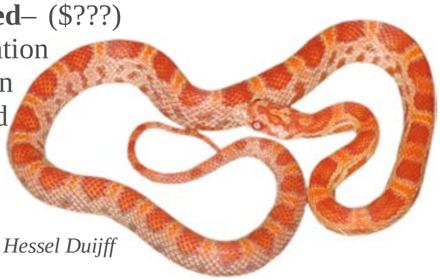


Photo by Hessel Duijff

Ultra/Ultramel + Lava – ($???) Currently unknown.

Ultra/Ultramel + Anery – ($100) This morph is still somewhat new. It seems that ultramel anerys and ultramel lavenders might turn out darker than would be expected.

Photo by Sean Niland, courtesy of John Finsterwald

Ultra/Ultramel + Charcoal – ($???) The first of these were produced in 2008.

Photo by Sean Niland – VMS Professional Herpetoculture

Ultra/Ultramel+Caramel – ($75-125) **Golddust** corns are similar to butters except the slight amount of melanin present makes them distinguishable from butters.

Photo by Don Soderberg – South Mountain Reptiles

Ultra/Ultramel + Lavender – ($???) These were first hatched in 2007. This morph may turn out to be darker than would have been expected from this combination of genes. The adult coloration is not yet known.

Photo by John Finsterwald

Photo by John Finsterwald

Ultra/Ultramel + Diffused – ($???) The first of these were produced in 2006. There are now a few breeders making them.

Ultra/ Ultramel + Motley – ($70-100) Some of these can be so light that they can be mistaken for amelanistic corns. They may even have white flecks on the dorsal pattern. A closer look at the eyes will show that they are not amels. The motley gene, as in other morphs, tends to smooth out the colors.

Photo by Kat Hall – CornQuest

Ultra/Ultramel + Stripe – ($???) The first of these were hatched in 2007. They are expected to resemble ultramel motleys in coloration. Future hatchlings will provide the answer to that question.

Photo by Stephen Wagner

The Hypo locus:

Allele	**Name**
H^+	Wild type
h^h	Hypomelanism

Genotype	**Known as:**
$H^+ \cdot H^+$	Wild type
$H^+ \cdot h^h$	Wild type (Het Hypo)
$h^h \cdot h^h$	Hypomelanistic

Hypo, aka **Hypomelanistic**, **Hypomel**, **Hypo A** ($20-$40)

Hypomelanism, as its name implies, has the effect of reducing melanin.

The oranges and reds are generally “cleaner” when compared to normal corns, the black borders are often thinner, and the belly checkers often are bronzed. But in some cases, the darkest hypos can be darker than light-colored normals.

Hypomelanism is recessive to its wild-type allele, so only homozygous specimens express the hypo phenotype. There is some debate about this, and it seems that in certain lines the hets might be somewhat lighter than their non-het siblings.

Although this trait is generally considered a “color” it also seems to affect the pattern, by reducing the size of the melanin-producing areas. The result of this “pattern change” can be thinner border areas and a white stripe down the belly where the checkers do not fully meet. Now that many various genetic combinations involving lava and sunkissed are being produced, it appears that hypo’s effect also includes a mild hypoerythrism or fading/dulling of the reds and oranges. This is suggested by the richer colors in the lava/sunkissed versions of these combinations.

Note that the thinner borders and bronzed belly checkers are not absolute indicators of hypomelanism and visual identification of adults can be tricky. If a cornsnake has lighter/cleaner colors, thinner than normal borders, or bronzed belly checks, it is not necessarily a hypo.

The best identification is made by comparing hatchlings, where hypos are usually quite obvious compared to non-hypo siblings. Hatchlings have a lighter brown/red tone to the saddles compared to normals. Some non-hypo corns will grow up to be extremely light, making identification of adults tricky. In cases where a hypo-like adult or subadult comes from unknown sources, breeding trials are the only way to determine the genotype.

Some of the examples include both male and female specimens, to demonstrate the visible differences typically found between the sexes.

The strawberry gene is believed to be an allele to hypo. It might be possible to sort strawberry corns from hypo corns using the hypermacro technique. Test breedings, to verify strawberry as an allele, are planned for this year.

Selectively-bred variations of Hypos:

Crimson, Hypo Miami ($40-70, varies greatly with quality)
These are what you would expect from adding hypomelanism to a typical Miami phase cornsnake. The look, especially the ground color, can vary depending on the stock a given breeder started with, and the direction they took their project. Some are clean gray, and others have a clean tan ground color. Hypos cannot be het for crimson or “Miami.”

Genetic combinations with Hypo:

Hypo + Sunkissed – ($???) This combination creates two additive "hypo" effects, making these snakes even lighter than either type by itself. The sunkissed pattern is visible, too.

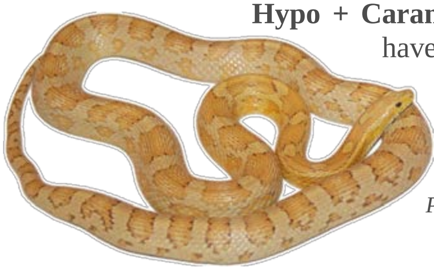
Photo by Deb Morgan

Hypo + Lava – ($???) The combination of these two genes is still very new. It remains to be seen how these two genes will interact. This specimen came from an Okeetee-like line of hypos.

Photo by Joe Pierce – CornSnakesAlive!

Hypo + Anery – ($30-50) **Ghost** corns are one of the most common double genetic combinations. They are a light version of anerythrism. Colors often turn to light browns, tans, and some ghosts develop "peach" and other pastel colors. As seen in these juveniles, males are lighter and more "colorful" than females.

Hypo + Charcoal – ($50-70) **Phantom** corns seem to be more of a niche morph than ghosts. They tend to be slightly lighter in color than ghost corns, but less colorful. Some will develop "purple" or "lavender" type tones, similar to what is seen in younger charcoal corns.



Hypo + Caramel – ($50-80) **Amber** corns have light brown saddles on a tan to yellow ground color. They are now being bred with the stripe and motley patterns.

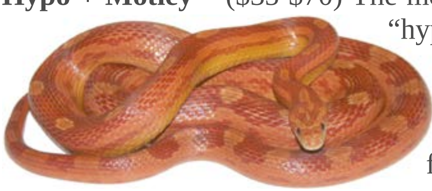
Photo by Russell Keys

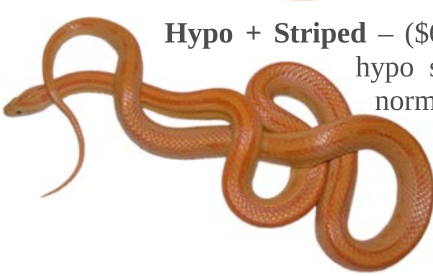
Hypo + Lavender – ($100-125) Young males expressing this combination can be very colorful. Females tend to be less affected by hypo, and can be mistaken for non-hypos by beginners. The overall colors are light compared to lavenders, and the pink/orange wash that develops in young lavenders can be even more apparent in hypos.

Hypo + Diffused – ($80-125) Most examples are out of bloodred lines and tend toward dark orange saddles on an orange ground color.

Photo by Russell Keys

Hypo + Motley – ($35-$70) The motley trait already has its own "hypo-like" effect. Hypo adds to this to create hypo motleys even lighter than normal motleys. This specimen is from the Strawberry lines.





Hypo + Striped – ($60-$100) Like hypo motleys, hypo stripes are even lighter than normal motleys or stripes.

Photo by Caroline Piquette – Breeding Colors

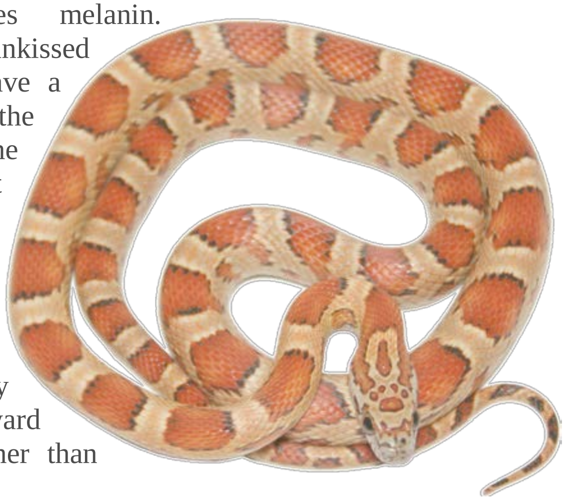
The Sunkissed locus:

Allele	Name
S^+	Wild type
s^s	Sunkissed

Genotype	Known as:
$S^+ \cdot S^+$	Wild type
$S^+ \cdot s^s$	Wild type (Het Sunkissed)
$s^s \cdot s^s$	Sunkissed

Sunkissed, **Sunkissed Okeetee, "Hypo Okeetee"** ($50-$75)

At first glance, sunkissed corns might resemble hypos. Like hypo, this trait reduces melanin. However, the sunkissed gene appears to have a significant effect on the pattern as well as the color. The simplest way to describe it is to say that it increases the amount of ground area, and erodes the saddles so that they tend more toward convex shapes, rather than concave shapes.

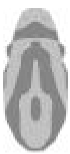


The example above is not typical of sunkissed corns commonly found on the market *at this time*. Since the gene originated in Okeetees, the vast majority of sunkissed corns are in fact sunkissed Okeetees or have a very strong Okeetee influence. More and more non-Okeetee sunkissed corns are being produced as byproducts of outcrossing them to other genetic lines, and the distinction between sunkissed and sunkissed Okeetee will become more important, so it is helpful to understand from the start that the sunkissed gene does not make a snake look like an Okeetee.

In some cases where the pattern is not as strongly affected, sunkissed might *mimic* hypo. In these cases, a visual ID of an otherwise unknown snake might not be 100% accurate. It is wise to ensure you know the genotypes of the parents, or perform breeding trials in order to make a positive ID.

A hypothesis, proposed and being investigated through breeding trials by Connie Hurley, is that the pattern and color effects of sunkissed are separable. If this turns out to be true, sunkissed could be a very good mimic of hypo. It will likely be a few more years before such a determination can be made with any certainty.

Normal



Sunkissed

Another distinctive characteristic of many sunkissed corns is the saddle-colored band going across the nose, which is thinned. Also common are the small dots on the nose. Note that many striped and other corns also have the thinned eye band. This is simply a result of increased ground area and reduced saddle area (via mutant genes or selective breeding) and does not mean that all snakes with thinned eye bands are sunkisseds.

The last characteristic that seems to be caused by the sunkissed gene is very strong belly checkering. In many examples the belly is more aptly described as white checkers on a black background. Sunkissed motleys have been found to possess belly checkers, and the same might hold true for sunkissed stripes.

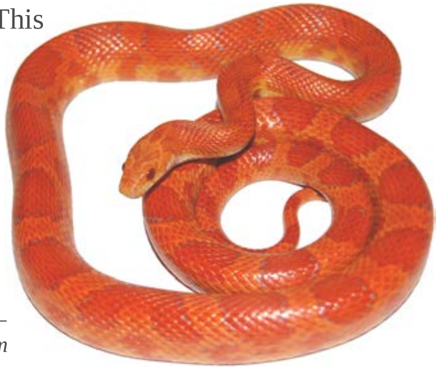
Currently, some corns labeled as “hypo Okeetee” are based on the standard hypo gene, and others on the sunkissed gene. Be sure you know which gene you are getting if you plan to breed to other hypos.

Selectively-bred variations of Sunkissed:

Sunkissed Okeetee ($50-75)

Since this gene originated within Kathy Love’s Okeetee lines, the first sunkissed corns were Okeetees. The majority of them on the market today are more okeetee-like than not.

Genetic combinations with Sunkissed:



Sunkissed + Lava – ($???) This combination is still quite new but appears to be what one would expect from the mixing of these two genes. Having Okeetee influence on both sides should help to create some very bright specimens of this morph.

Photo by Robin Teeninga – www.rrsnakes.com

Sunkissed + Anery – ($???) Several sunkissed anerys were hatched in 2008. So far it seems likely that they will take on similar colors to ghost corns, combined with the distinctive sunkissed pattern.

Photo by Susan Willis - Willis Wildlife Enterprises

Sunkissed + Charcoal – ($???) A handful of these currently exist. It appears they will have phantom-like colors with the sunkissed pattern.

Photo by Jeff Mohr - Mohrsnakes

Sunkissed + Caramel – ($???) This morph might turn out to show higher contrast and brighter colors than ambers. Several lines are now being produced so the range of variation should become more obvious over the next few years.

Sunkissed + Lavender – ($???) Only a few of these exist so far. It appears these will be very similarly colored to hypo lavenders. However the females might not be as dark as female hypo lavenders.

Sunkissed + Diffused – ($???) The interaction of these two genes could take a number of different forms. Its first appearance, possibly in 2009, is highly anticipated.

Photo by Jay & PJ Coombs - PJC Reptiles

Sunkissed + Motley – ($???) Instead of the connection between saddles, rounded saddles may curve somewhat toward each other, but not completely connect. Belly checkers also can appear on some sunkissed motleys, although they don't tend to be as numerous as a typical snake.

Sunkissed + Striped – ($???) Given the increased areas of ground color in both morphs, it is predicted that these two traits will be additive and drastically reduce what little saddle color exists on the snake.

Photo by Jeff Mohr - Mohrsnakes

The Lava locus:

Allele	**Name**
V^+	Wild type
v^v	Lava

Genotype	**Known as:**
$V^+ \cdot V^+$	Wild type
$V^+ \cdot v^v$	Wild type (Het Lava)
$v^v \cdot v^v$	Lava

Lava ($70-$100)

This is the third hypo-like trait to be discovered and is also a recessive mutant. It acts similarly to the others in that it reduces melanin and creates a brighter overall appearance.

Hatchlings can appear almost amelanistic. The eyes have a ruby glow as a result of the extremely reduced melanin. Some specimens exhibit splotches of black, as if the gene's effect was not complete on that scale. This is often called a "paradox lava." Also, some specimens can have an interesting look about certain areas of scales, almost as if they have been coated in wax. Two main bloodlines exist. One is a "landrace" lava line which traces its roots back to wild corns. The other lavas have been crossed into various domesticated lines to produce genetic combinations.

It is hypothesized that the lava trait might also enhance the oranges in the ground color. The lava gene has now been outcrossed into a good number of unrelated lines in order to create hets for various genetic combinations, and future comparison of F2 and more outcrossed lavas to their siblings should shed light on the hypothesis. As it stands the vast majority of lava corns today exhibit increased orange coloration.

Genetic combinations with Lava:

Lava + Anery – ($150-200) A more extreme ghost-like morph is the ***Ice*** corn. Many subtle colors, such as a blue tint on the head, as well as pink undertones on the body, have been seen in this morph. Males can be very colorful and tend to be much lighter. Pictured are a male and female together to show the differences typically found between the sexes.

Lava + Charcoal – ($???)A few of these were hatched in 2008.

Lava + Caramel – ($???) The first of these were hatched in 2006 and dubbed ***Topaz*** corns. This specimen has ruby pupils and green irises.

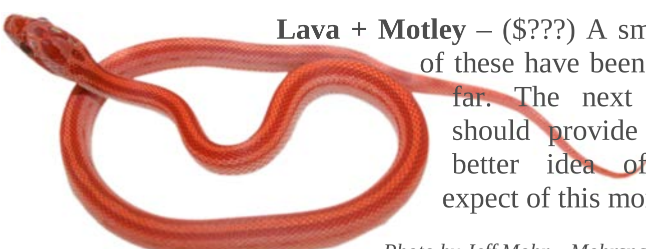
Photo by Dean Arnold

Lava + Lavender – ($???) The first of these corns were hatched in 2004. It appears that these may be the most extreme version of hypo lavender. The eyes can be just as red/pink as those of amelanistic corns.

Photo by Hessel Duijff

Lava + Diffused – ($???) This new combination appears to be what one would expect when combining these two morphs.

Photo by Carol Huddleston – Low Belly Reptiles



Lava + Motley – ($???) A small number of these have been hatched so far. The next few years should provide us with a better idea of what to expect of this morph.

Photo by Jeff Mohr – Mohrsnakes

Lava + Striped – ($???) Striped Ice (lava anery) corns have been produced, but striped lavas have not been hatched yet.

The Dilute locus:

Allele	Name
Dt^+	Wild type
dt^d	Dilute

Genotype	Known as:
$Dt^+ \cdot Dt^+$	Wild type
$Dt^+ \cdot dt^d$	Wild Type (Het Dilute)
$dt^d \cdot dt^d$	Dilute

Dilute ($150)

The dilute gene is the fifth hypo-like gene found in corns. Its effects are more subtle than hypo. The dilute gene also appears to "cool" the overall coloration. The cooling effect may be due to adendritic pigment cells, causing the pigment to be partially hidden behind the iridophore layers. This idea is supported by the observation that all but a small part of the head pattern is invisible in the sheds of these snakes, so that their sheds closely resemble those of a snow or lavender corn.

Photo by Deb Morgan

Identifying a dilute specimen is still in its infancy and at this point should be trusted to breeding trials instead of visual identification of specimens from unknown heritage. However, the clear sheds might (*or might not*) eventually prove useful as a method of identification.

Since it was originally proven in anerys, the normal phase had been unknown. Dilute has been outcrossed with several different morphs and was finally produced in normal phase (red-producing) corns in 2007. Other combinations have been produced in small numbers, such as dilute lavender and dilute caramel. New genetic combinations are expected to appear over the next few years.

Genetic combinations with Dilute:

Photo by Jeff Mohr – Mohrsnakes

Dilute +Anery–($150) Also sometimes called "blue" (especially with "blue motleys") these snakes start with an appearance between that of anery and ghost in overall lightness. Instead of the warm browns and pastels found on anery/ghost corns, dilutes have more of a steely blue-gray appearance. Known specimens tend to accumulate pastel pinkish ground colors, especially males.

Photo by Sean Niland – VMS Professional Herpetoculture

Dilute +Charcoal –($???) The first of these were hatched in 2008. There are at least a few separate projects with these, so they should become well known within a few years.

Dilute + Caramel – ($???) One of these was hatched in 2007, but failed to thrive. It was reported that the coloration was just what one would expect from this genetic combination.

The Anery locus:

Allele	Name
An^+	Wild type
an^a	Anery

Genotype	Known as:
$An^+ \cdot An^+$	Wild type
$An^+ \cdot an^a$	Wild type (Het Anery)
$an^a \cdot an^a$	Anerythristic

Anerythristic, aka **Anery**, **Anery A**, **Black Albino** ($20 -$30)
*Pronounced "**An**-ur-uh-**thris**-tik," or abbreviated to "**an**-ur-ee."*

This trait takes away the red and orange coloration, leaving the snake shades of blacks, grays, and browns. The anery mutant is recessive to its wild-type allele. This is one of the most common mutants in the cornsnake population and it has been combined with nearly every other mutant.

The typical yellows on the chin/neck/belly are unaffected by anery. Although all corns have a pinkish "blush" tone on their cheeks, it tends to be much more noticeable on anerys than most other morphs.

A few red freckles may appear on the body of the snake. These usually appear after a shed, and can stay for the rest of the snake's life. Hatchlings are an attractive black and silver but the saddle colors often fade to browns, tans, or peach/pastel tones. Sexual dimorphism in anerys (and ghosts) is usually rather obvious, where males are typically more "colorful" and lighter than females.

Selectively-bred variations involving Anery:

Pastel Ghost, Pastel Motley, Pastel Ghost Motley ($50-65, varies)
Individual breeders use all of these terms differently. Generally it refers to softened pinkish saddles and/or ground colors on a number

of different anery-based cornsnake morphs. The males tend to be more colorful and “more pastel” than the females.

Photo by Russell Keys

Some anerythristic motleys will get as light as ghosts and are sometimes referred to as “ghost motley” even though no hypomelanism is present. Some breeders will only use the term “ghost” when hypomelanism is present, and some will use the term based only on how light-looking the colors are.

It is a good idea to find out from the breeder which genetic combination is being expressed, especially whether or not hypo is being used in each combination. Until/unless a genetic influence causing the “pastel” look has been isolated and proven out, ghost corns cannot be het for “pastel.”

Coral Snow ($???) – These were originally assumed to be hypo snows, and currently the term “coral snow” is used for either situation. These particular snows are believed to involve selective breeding (or a currently unidentified gene) to bring out the intense coral colors. They can be colorful enough to be mistaken for amelanistics in some photos. Be sure you know which “type” of coral snow you are buying.

Pink and Green Snow, Green Blotched Snow ($???)
Some snows and amelanistics can have bright yellow saddles, and show a greenish cast in the areas where the black borders exist on normal cornsnakes. Some breeders have enhanced this trait through selective breeding. These are dubbed “pink and green” snows. They are sometimes referred to as “bubblegum” snows, although a line of ratsnake hybrids is also called “bubblegum.”

Genetic combinations with Anery:

Anery + Charcoal – ($???) Individuals of this genotype must certainly exist by now, but few have been formally identified. It is expected that they will look like an intermediate of the two.

Anery + Caramel – ($50-$80) It appears that caramel is unable to exert its influence when anery is showing. That is, caramel is masked by anery. As a result, these individuals are expected to look like any other anery.

Anery + Lavender – ($80-100) Some cornsnakes are known homozygous for both traits, and look like typical lavenders. Meanwhile other known anery lavenders take on an intermediate appearance. Also, corns of the triple combination of anery, lavender, and amel appear to look like typical snows. One theory is that lavender can mask the expression of anery, except when amel is present. There is still plenty of mystery remaining in this morph.

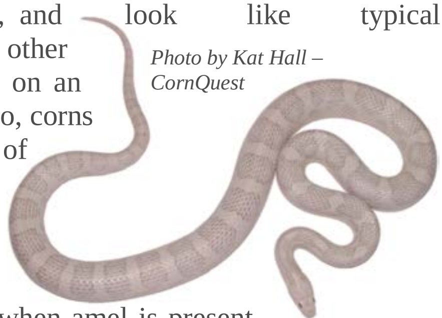


Photo by Kat Hall – CornQuest

Anery + Diffused – ($75-125) Some male ***granite*** corns can have odd "pink" tones to their sides. This tendency appears to run in families, and it can be obvious enough that males and females in these clutches can be visually identified based on their colors. Dimorphism typical of other anerys is also apparent in granites.

Female specimen

Anery + Motley – ($35-70) Many of these are similar in coloration to ghost corns. As with almost all motley corns, the smoothing of colors and checkerless belly are present.

Photo by Kat Hall – CornQuest

Anery + Striped – ($50-65) These are similar in color schemes to anery motleys. Some examples of this morph can become almost patternless. A few breeders are making an effort to produce totally “patternless” cornsnakes through this and a few other morphs.

The Charcoal locus:

Allele	Name
Ch^+	Wild type
ch^c	Charcoal

Genotype	Known as:
$Ch^+ \cdot Ch^+$	Wild type
$Ch^+ \cdot ch^c$	Wild type (Het Charcoal)
$ch^c \cdot ch^c$	Charcoal

Charcoal ($30-$40)

This was the second anery-like trait to be discovered, and in many ways it mimics anery. As in anerys, the pinkish “blush” on the cheeks stands out.

As a broad generalization, charcoals have a darker ground color and are lower in contrast than anerys. However, there is so much variation in both anery and charcoal that they often look similar to each other. Hatchlings generally have a purplish cast to them, and tend to look slightly different than anery hatchlings, enough that experienced breeders can pick them out of a crowd. Adults sometimes cannot be reliably identified by looks alone, so be sure you know which type you are getting if you plan to breed them.

A common myth is that charcoals do not develop yellow on the chin/neck and that anerys do. Originally this was true, but this myth has been dispelled as charcoals with yellow on them, and anerys without yellow, have appeared. The appearance or absence of yellow is **not** a reliable way of determining the difference, although a trained eye can often spot differences in the *quality* of the accumulated yellow.

Genetic combinations with Charcoal:

Charcoal + Caramel – ($???) Currently unknown.

Charcoal + Lavender – ($???) This combination is still very new, but several projects to produce these are in the works.

Photo by Sean Niland – VMS Professional Herpetoculture

Charcoal + Diffused – ($100-$125) ***Pewter*** corns range from very dark to very light. This is a niche morph: people tend to either love pewters, or find them uninteresting or unattractive.

Charcoal + Motley – ($???) This morph is still in its infancy. It is unknown if these will resemble anery motleys, if they will take on colors similar to phantom corns, or if they will have a new look of their own.

Photo by Jeff Mohr – Mohrsnakes

Charcoal + Striped – ($???) This combination was first produced in 2004 but like many striped morphs has remained uncommon over the years.

Photo by Jeff Mohr – Mohrsnakes

The Caramel locus:

Allele	Name
Ca^+	Wild type
ca^c	Caramel

Genotype	Known as:
$Ca^+ \cdot Ca^+$	Wild type
$Ca^+ \cdot ca^c$	Wild type, Het Caramel (varies)
$ca^c \cdot ca^c$	Caramel

Caramel ($20-$40)

Photo by Caroline Piquette – Breeding Colors

Caramel appears to remove the red pigmentation. Many caramels have a yellow wash over the entire body. The result is a corn in subtle shades of yellows and browns.

This is not the same type of thick, dark yellow that accumulates on the neck/chin of cornsnakes. In fact, the accumulated yellows can easily be seen on caramels. Some have little or no extra yellow wash, and it is unclear whether this is simply the result of selective breeding, an influence of the caramel trait, or the result of a secondary trait.

Another way to view this trait is to see it as one that turns the red/orange pigments *into* yellow. The removal of reds acts like a recessive trait and is only expressed in homozygous specimens. Meanwhile the augmented yellow often appears in hets, usually beginning several sheds after hatching, suggesting that this part of the phenotype acts like a codominant trait. The amount of yellow tends to vary in line with what would otherwise be the amount of orange on the snake's ground color. On "Miami phase" specimens, the hets can turn a particular shade of yellowish tan.

Saddles on caramel hatchlings are brown. Some hatchlings can look very similar to anerythristic hatchlings before the yellows appear.

Genetic combinations with Caramel:

Caramel + Lavender – ($???) This combination is still new and it is unknown what the typical look will be.

Photo by Kat Hall - CornQuest

Caramel + Diffused – ($???) This combination is starting to become more common, and might become readily available on the market soon.

Photo by Walter Smith

Caramel + Motley – ($40-65) As with other motley-based and stripe-based combinations, many of these tend to take on a "hypo" appearance and have lighter colors than standard caramels. Pictured is a hatchling, with only the first hint of any yellow in the ground color.

Caramel + Striped – ($95-175) As with other motley-based and stripe-based combinations, many of these tend to take on a "hypo" appearance and have lighter colors than regular caramels.

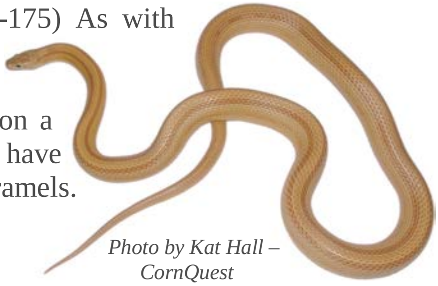


Photo by Kat Hall – CornQuest

The Lavender locus:

Allele	Name
L^+	Wild type
l^l	Lavender

Genotype	Known as:
$L^+ \cdot L^+$	Wild type
$L^+ \cdot l^l$	Wild type (Het Lavender)
$l^l \cdot l^l$	Lavender

Lavender ($60-$100)

The lavender gene is considered recessive to its wild-type allele. As adults, lavenders end up with a pattern made of dark and light shades of an odd gray color. It is impossible to describe in words. Lavenders *must* be seen in person to be fully appreciated.

Hatchlings can appear somewhat similar to anery hatchlings but have a lighter "brown" saddle color. It seems there are two general classes of lavenders, those that are "mocha" colored and those that are more of a neutral gray. These differences may or may not be more commonly sex-linked with the males being the lighter specimens and the females being the "mocha" variety.

As juveniles, many lavenders will have an odd wash of ground color. This wash can be orangish, pinkish or purplish, and as they become adults it fades. Many lavenders will have ruby-colored eyes. But this is not a sure-fire indicator that an individual is a lavender, since there are several other morphs that also have ruby eyes.

Many lavenders, and normal corns from lavender lines, also have unusual patterns resembling *aztec* and *zigzag*. It is unclear whether or not this is directly related to, or linked to, the lavender trait. Normally patterned lavenders can also produce offspring with these odd patterns.

Genetic combinations with Lavender:

Lavender + Diffused ($150-250) – The ***plasma*** corn is the subject of many projects and is expected in good numbers over the next few years. Overall darkness is highly variable between individuals. Some appear to resemble light-silvery pewters and others resemble dark gray pewters, but with less of the browns.

Photo by Walter Smith

Lavender + Motley ($60-120) – Lavender motleys have become more popular over the last several years and are becoming available and affordable. As with other lavenders, colors are highly variable between individuals.

Lavender + Striped ($???) – These are still hot items, since only a few of them exist. Several breeders are now working with them and they will likely become more common in the coming years.

Photo by Sean Niland –
VMS Professional Herpetoculture

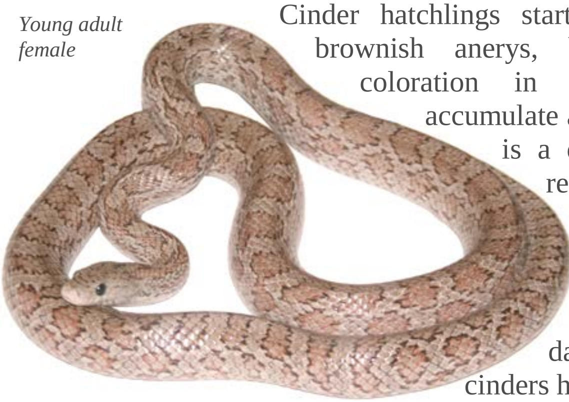
The Cinder locus:

Allele	Name
Ci^+	Wild type
ci^c	Cinder

Genotype	Known as:
$Ci^+ \cdot Ci^+$	Wild type
$Ci^+ \cdot ci^c$	Wild Type (Het Cinder)
$ci^c \cdot ci^c$	Cinder

Cinder ($???)

Young adult female



Cinder hatchlings start out looking like brownish anerys, but an odd red coloration in the saddles can accumulate as they mature. This is a different quality of red compared to other corn morphs. The accumulated “red” can then fade back out in adults. To date, only a few adult cinders have been observed.

Belly pattern

It is unclear at this point if an odd pattern effect is also caused by this gene. There are two different general classes of patterns that have been observed. One is a typical corn pattern. The other pattern has jagged edging to the saddle shapes. Breeding tests over the next several years should shed some light on the nature of the odd pattern, but at this time it appears to be reliably heritable. Cinders are being outcrossed into other morphs to begin the process of making combination morphs. Amel cinders *(see page 22)* have been produced already, and hypo cinders will likely be the next to appear.

The Kastanie locus:

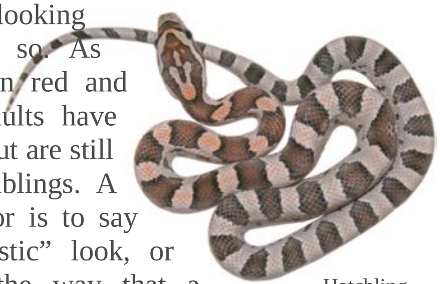
Allele	Name
K^+	Wild type
k^k	Kastanie

Genotype	Known as:
$K^+ \cdot K^+$	Wild type
$K^+ \cdot k^k$	Wild Type (Het Kastanie)
$k^k \cdot k^k$	Kastanie

Kastanie *(pronounced kah-**stahn**-yeh)* ($???)

This gene was first recognized and proven as a mendelian recessive trait in Germany. It was later discovered in the North American captive population when a "rosy blood" corn was outcrossed and the kastanie trait appeared in two of the grandchildren.

Photo by Michael Glaß



Hatchling

Kastanie corns hatch out looking either anerythristic or nearly so. As they mature, they slowly gain red and orange pigments. Existing adults have grown toward normal colors, but are still visibly different from their siblings. A simple description of the color is to say they take on a "hypoerythristic" look, or "reduced red pigment," in the way that a hypomelanistic corn is intermediate between normal and amel.

Genetic combinations with Kastanie:

Kastanie + Amel – ($???) This combination goes by the trade name of **mandarin** in Germany.

Photo by Michael Glaß

Photo by Don Soderberg–
South Mountain Reptiles

Kastanie + Diffusion – ($150) These have been around for years under the trade name **rosy blood**, but it was recently discovered that they were using the kastanie gene. This will help speed up the process of making new combinations with kastanie since there are many existing adults to start projects.

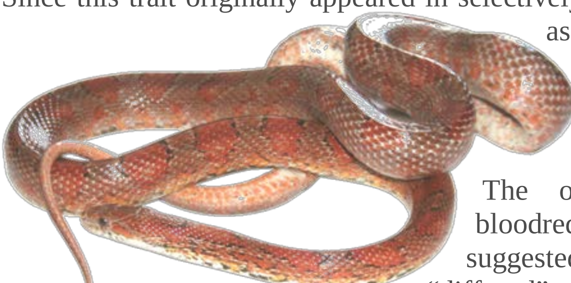
The Diffusion locus:

Allele	Name
D^+	Wild type
D^D	Diffusion (*also called "Bloodred"*)

Genotype	Known as:
$D^+ \cdot D^+$	Wild type
$D^+ \cdot D^D$	Intermediate (*ranges from normal to almost fully diffused pattern*)
$D^D \cdot D^D$	Diffused pattern (*also called "Bloodred"*)

Diffused *(Also called **Bloodred** or **Blood**)* ($50-$90)

Since this trait originally appeared in selectively bred corns known as bloodreds, the name "bloodred" is still often used for the gene.



The originators of the bloodred corns have suggested using the name "diffused" for this gene/trait/pattern in order to avoid confusing the genetic pattern mutant with the selectively bred color morph. The Cornsnake Morph Guide uses that convention in order to clearly separate discussions of the diffusion pattern trait from the selectively bred bloodred morph.

Three main effects on the pattern are observed. The belly is wiped clear of checkers. However, some black specks or freckles can appear. The head pattern is often stretched, and the top of the head can have a "skull" type pattern on it.

The pattern on the side of the body can be practically normal, or almost completely blurred out. (The more diffused/blurred side patterns are usually more desirable.) The diffusion pattern (like motley) often creates a mild lightening effect similar to (but not related to) hypomelanism.

Hatchlings may start out with a lot of gray on the head and ground areas, which then develops into the reds, oranges, or browns they will have as adults. In this morph, the ground color can become darker than the saddle color.

Many breeders have also observed that in full clutches of known hets, male hets will show much more of the traits than the female hets. The differences may be obvious enough to identify males and females by looking at their patterns. It's possible that this difference is either related to or a direct result of the *masque* gene.

Diffusion is a Mendelian pattern trait, but its expression can vary between individuals. It tends to act mostly like a recessive gene, but some hets may show hints or significant amounts of the diffused pattern. The amount of expression seems to be fairly consistent within each bloodline, which suggests the diffusion gene is *not* the cause. Even the most extreme-looking hets generally do not express the "blurred" side pattern, and they will show traces of rectangular markings on the edges of the belly. If you purchase or hatch hets for diffusion, don't count on them looking severely different from normals.

Selectively-bred variations using Diffusion:

Bloodred ($60-$120)

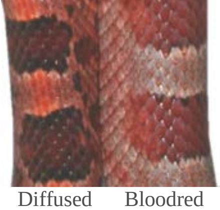
This term is also used by some as the name of the diffusion gene. Selective breeding of individuals expressing the diffusion pattern trait originally created extremely red individuals, which were practically patternless. But some of that quality has been lost in many lines as a result of outcrossing.

“Bald” head pattern and uncheckered ventral pattern with red wash, typical of Bloodred corns

The bloodred morph appears to be made of diffusion plus three additional characteristics: masque, borderlessness, and increased red pigments. The masque and borderless components each appear to be under the control of independent dominant genes, but breeding trials are still underway in an attempt to determine this. The increased red appears to be a selectively bred trait rather than a gene. Since there are strong genetic influences in the best specimens, some F1 offspring from “bloodred x normal” crosses can practically look like bloodreds themselves.

Cornsnakes expressing the simple genetic diffusion pattern trait *and* cornsnakes with the ideal look, and everything between, are called “bloodred” corns by many people. There can be a great deal of difference in the quality of the pattern and the quality of the coloration, so if you want the selectively bred “bloodred” morph, be sure to find out from the seller what you are getting.

Hatchling comparison



Diffused Bloodred

Typically the best bloodreds will hatch with a completely patternless gray head or with a gray “skull” type head pattern, a belly with no black checkers or specks on it, side blotches that are very smudged or even invisible, or a side pattern that is a smudge of saddle color, and very little visible “black” anywhere. As they mature, the ground color on high-quality specimens turns from gray into red. The "color" on the ground is not the typical oranges, or tans/browns, but rather the saddle color coming in where the pattern has been diffused. It can take 5 years for a bloodred to reach its "final" coloration but the first 1-2 years can give a good indication of the changes that will occur.

Genetic combinations with Diffusion:

Diffused + Motley – ($???) Several potentials were hatched starting in 2006, and within the next few years, proven specimens should become more widely available.

Photo by Arjan Coenen – Corns.nl

Diffused + Striped – ($???) Like Diffused motleys, these need to be proven through breeding trials. Proven specimens exist and are becoming more common. They are also being produced in combination with anery, amel, snow, and ghost.

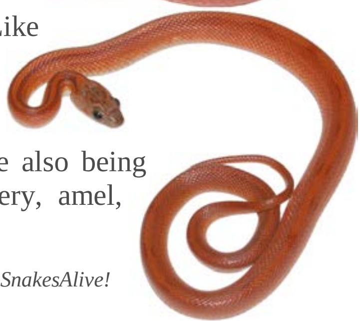


Photo by Joe Pierce – CornSnakesAlive!

Pied-sided ($???)

The pied-sided trait may be related to the diffusion trait. At this point it has proven to be a single gene. What has not been determined yet is whether the mutant is on a new locus, or if it is an allele on the already known diffusion locus. It will take several years to make such a determination. A gene symbol may be Assigned at that time.

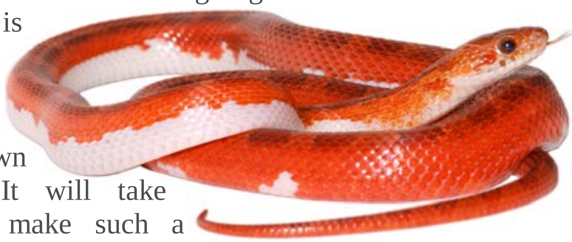


Photo by Don Soderberg – South Mountain Reptiles

The pattern is affected in two main ways. The most obvious characteristic is the white patches that can look like the belly pattern has been extended up to the sides. The second effect is a severe "cutoff" of the patterning on the dorsal/lateral line. At this line, the pattern on pied-sided corns simply disappears and is replaced with a strong wash of non-patterned reds. It almost appears as if this trait is a more extreme expression of the diffused pattern, with pattern migration slowed so severely that the belly whites and belly reds end up on the side of the snake. Some specimens have one or two white scales on the nose.

Since it has only been observed in bloodred corns, it is unknown if pied-sided will have any effect in the absence of the diffusion gene.

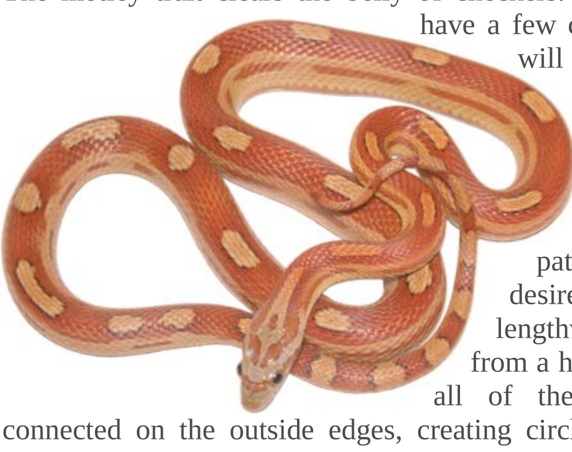
The Motley locus:

Allele	Name
M^+	Wild Type
m^m	Motley
m^s	Stripe

Genotype	Known as:
$M^+ \cdot M^+$	Wild type
$M^+ \cdot m^m$	Wild type (Het Motley)
$M^+ \cdot m^s$	Wild type (Het Stripe)
$m^m \cdot m^m$	Motley
$m^m \cdot m^s$	Motley, het Stripe *(motley pattern)*
$m^s \cdot m^s$	Striped (*Four-line stripe*)

Motley ($m^m \cdot m^m$) ($30-$40)

The motley trait clears the belly of checkers. Some motleys will have a few checkers, and many will have black freckles on the belly. A wash of color can also be found in some motley corns. The dorsal pattern often shows a desire to stretch lengthwise. Anywhere from a handful of saddles to all of the saddles will be connected on the outside edges, creating circles along the back.



Some normal (non-motley) corns have a "pseudo-motley" pattern on their necks, so the belly is important for proper identification.

The side pattern can be unaffected, or it can be smeared out into dashed lines. In some cases, the side pattern is virtually nonexistant. The motley pattern also creates a lightening effect similar to (but not related to) hypomelanism. For instance, anery motleys are usually lighter than anerys, hypo motleys are generally lighter than hypos, caramel motleys are generally lighter than caramels, etc.

Checkerless belly of motley and striped corns

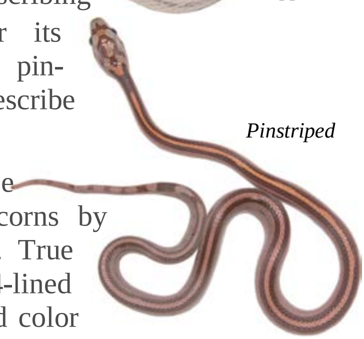
Be aware that the patterns produced by this trait are **highly** variable. This is why it is named *motley*. A wide variety of dorsal patterns can result, even in siblings from the same clutch.

Selectively-bred variations of Motley:

Pin-Striped and Q-tip Motleys ($40-$75)

Some motleys have elongated saddles and intermittent stripes down the centerline, or a single pinstripe down the back. These are often referred to as "motley/stripe" or "striped motley" but problems arise with these names because it is then unclear whether the term is describing the snake's genotype (m^sm^m) or its phenotype. To avoid this situation, pin-striped and q-tipped are used to describe these variations.

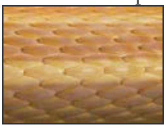
Q-tipped



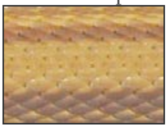
Pinstriped

Pin-striped motleys can usually be distinguished from "true striped" corns by examining the width of the stripes. True striped corns (also known as 4-lined stripes) have a wide stripe of ground color and thin saddle stripes. Pinstriped corns have a central stripe that

$m^m \cdot m^m$ Pinstriped



$m^s \cdot m^s$ Striped



is thin, or varying in width. On pinstriped corns the central stripe is usually broken on the neck. On striped corns the center stripe connects with the head pattern.

Miami Motley ($???)

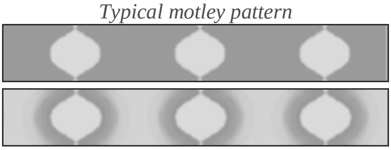
A few motley and motley/striped corns have been bred to take on the “Miami phase” look. This combines the motley pattern with a smooth silvery gray or light tan ground color. Cornsnakes cannot be het for “Miami.”

Photo by Carol Huddleston – Low Belly Reptiles

Hurricane Motley (varies widely)

This variation of the motley pattern, also sometimes called *donut* or *bullseye* motley, includes dark outlines around the circles caused by a thickening of the “border” areas, and/or fading of the central part of the saddles. In the best specimens the ground and saddles match, leaving only the circles.

Typical motley pattern



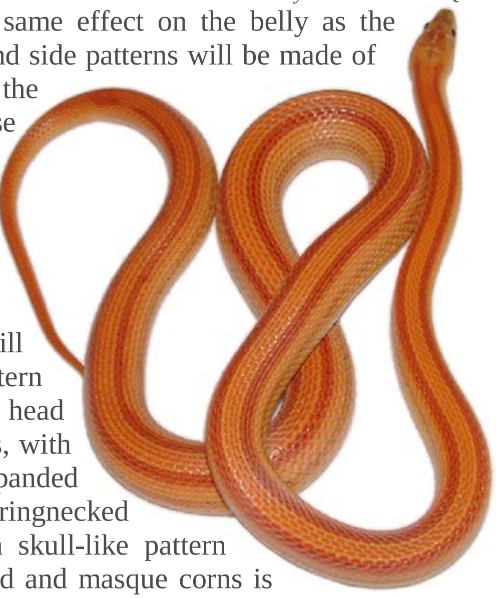
Hurricane motley pattern

Hurricane motley is found in several color morphs, and are often priced significantly higher than normal motleys of the same color, depending on the quality of the effect.

Photo by Don Soderberg– South Mountain Reptiles

Striped ($m^s \cdot m^s$) ($35-$50)

Photo by Kat Hall - CornQuest



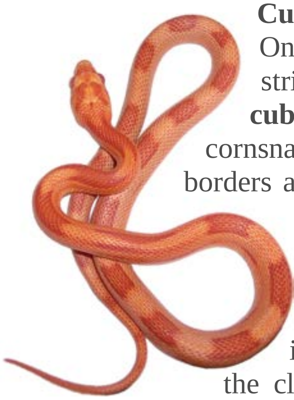
The striped trait has the same effect on the belly as the motley trait. The dorsal and side patterns will be made of four thin stripes running the length of the body. These stripes almost always have breaks in them, especially toward the tail. Fully striped corns with no breaks are rare.

Many striped corns will have an unusual head pattern that can resemble the head patterns of bloodred corns, with a tendency toward an expanded head blotch, and/or the ringnecked pattern. In many cases a skull-like pattern reminiscent of the diffused and masque corns is visible. As with motley corns, the striped pattern lightens the overall colors.

Striped corns also lack the black borders around the saddle-colored areas. When the markings are stripes, this is less obvious, but it becomes more apparent in cubed and sunspot varieties, and can be a helpful way to tell motleys apart from stripes.

The stripe allele appears to be recessive to the motley allele. This means that a snake of the genotype $m^m \cdot m^s$ is expected to take on the pattern of a motley corn. It was previously considered codominant with motley and intermediate phenotypes were expected any any such snakes, but that theory has been proven false. The "striped motley" (pin-striped or q-tipped) phenotype is more likely the result of other influences unrelated to the stripe gene. For this reason, the ambiguous term "motley/striped" is being replaced with *pinstriped* or *q-tipped* or other similar terms in order to avoid confusion.

Selectively-bred variations of Stripe:



Cubed ($???)

One of the odd patterns that has appeared in striped and/or motley lines is referred to as **cubed**. Genotypically, these are striped ($m^s m^s$) cornsnakes. As with other stripes, the saddle borders are completely absent. In the various types of cubes, some or all of the striping can be replaced by squares, x-shaped saddles, or ovals. The ovals are also called **sunspots**. Breeding trials have shown that the pattern is most likely a selectively bred variation of the classic striped pattern and that there is no "cube" allele at the motley locus.

Photo by Terri Manning – The Snake House

Vanishing and Patternless Stripes ($???)

Other variations that have originated in striped lines are known as vanishing stripe and patternless. It appears that vanishing stripe corns are selectively bred striped corns. Patternless also appears to be related to striped corns. It is being investigated by Jeff Mohr as a potential on/off gene, and might be proven out over the next several years.

Photo by Terri Manning – The Snake House

Terrazzo ($???)

Terrazzo is a recessive pattern mutant that originated in upper keys corns. Results so far from test breeding suggest it is not an allele to the motley and stripe mutants in corns. A gene symbol will be assigned once the locus has been determined.

Photo by Tim Jasinski, courtesy of Jeff Galewood – JMG Reptile

The checkerless belly pattern resembles those of motley and striped corns. Jeff Galewood has reported that the saddle colors vary throughout the range of corn saddle colors and the background color has been consistently light or gray tones so far. This coloration could be a result of natural selective breeding in the bloodlines of their ancestors, and like with motley or striped corns, it may be possible to breed terrazzo corns in the orange/red end of the spectrum by crossing to lines with intense orange ground colors, such as okeetee corns.

Photo by Tim Jasinski, courtesy of Jeff Galewood – JMG Reptile

Genetic combinations with Terrazzo:

Terrazzo + Amel – ($???) This new genetic combination was hatched in 2008. It has been dubbed "zolatone."

Photo by Tim Jasinski, courtesy of Jeff Galewood – JMG Reptile

Tessera ($???)

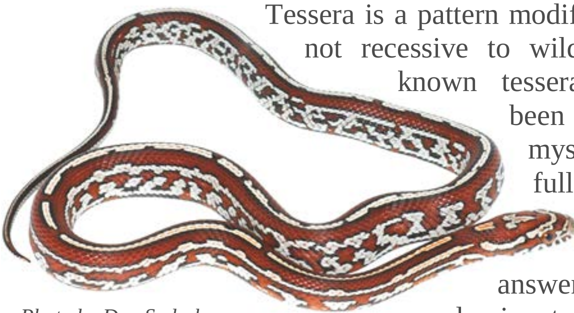


Photo by Don Soderberg – South Mountain Reptiles

Tessera is a pattern modifying gene which is not recessive to wild type. So far all known tessera specimens have been heterozygous. The mystery of whether it is fully dominant or codominant to wild type may be answered in 2009. If it is codominant to wild-type, the homozygous specimens will express another new mutant phenotype different from the above.

The advantage of dominant and codominant genes is that they can be propagated more quickly into visible morphs, and the difficulties in dealing with and testing out possible hets do not exist because heterozygotes express the mutant gene. With some codominant mutants the gene is valued in the heterozygous state, and lethal or otherwise undesirable in the homozygous state. This occurs in merle dogs, frosty doves, and many other miscellaneous genes in horses, mice, and other domesticated animals. In the event of a lethal gene it will likely take longer to determine that is what's happening. The clutches may simply be smaller than expected, or the result of the lethal gene could resemble other incubation problems. However, if any codominant mutant is found to be lethal homozygous it would be very easy for breeders to avoid this result, since homozygous specimens only would come about by breeding two (visibly morphed) heterozygous specimens together.

The dorsal patterns of tessera corns seem fairly consistent. The ventral patterns can be checkered or checkerless, and it is unknown at this time if this is a normal variation of the morph, or if the checkerless bellies are a result of the motley gene.

It has not been determined whether tessera is on the motley locus or its own locus. If it resides at the motley locus, it would be dominant to motley, and dominant or codominant to wild type, and recessive to stripe. This would make for an interesting situation with circular dominance: motley is dominant to stripe, which is dominant to tessera, which is dominant to motley, *repeat*.

Other Genes

Masque:

This appears to be a weakly-expressed mimic of the diffusion gene. Masque gene seems to be more of a minor modifier than a major morph-generating pattern, and it may not even be listed or noticed by many breeders. It might not have enough of an overall effect to warrant classification in the same category as the other color/pattern genes. But it is worth mentioning for those who enjoy the more subtle variations in corns

The masque gene has been test-bred against diffusion and has proven to be independent of the diffusion locus. More samples are needed to determine the inheritance for certain, but at this time it appears to be sex-linked, and it usually acts dominant (or semi-dominant) in males and seems to have little effect on females.

The phenotype may be undetectable in females and for the sake of discussion will be treated as if it is only expressed in males. As such, the following description applies almost entirely to the males. The overall scheme is one of expanded ground color and a very mild hypomelanistic effect. The head pattern tends toward a “skull” shape with two oval-shaped “eyes” formed by the saddle color. It can take many forms that tend to resemble ink blots, and what they all tend to have in common is expanded ground color on the head.

The belly has a “white stripe” where the checkers do not reach the center. The sides may show a slight blurring, but at this point it’s possible that this characteristic is part of the existing bloodlines and not a result of the masque gene itself.

To date there are no known homozygous males (and it is assumed females can only be hemizygous) so the phenotype of homozygous males is unknown, and assumed to be either the same as or more extreme than heterozygous males. Test crosses are still ongoing.

If masque is sex-linked, the inheritance patterns will not be exactly the same as normal mutant genes. Males have two Z sex chromosomes, and females have one Z, one W.

As usual, a homozygous male will pass this gene to all of his offspring and a *hetero*zygous male will pass this gene to half of his offspring. However, since females are ZW, they can only be hemizygous, and can carry at most one copy of the gene on their single Z chromosome (and nothing on the W chromosome.) All offspring receiving the Z chromosome are male and all offspring receiving the W chromosome are female, so a hemizygous female will pass this gene to **all** of her sons and **none** of her daughters. From the opposite perspective, males can inherit the masque gene from either parent, but females can only inherit masque from their father.

As a result, outcrossing a normal-looking hemizygous female will produce masque sons and normal-looking (non-carrier) daughters. Meanwhile, outcrossing a heterozygous masque male will produce normal-looking (50% possible carrier) daughters, and a split of normal (non-carrier) and masque sons.

Identification of this gene can be tricky. Since it is a good mimic of many hets for diffusion, a visual ID alone cannot determine which gene (diffusion or masque) is responsible for the phenotype. Also, in clutches where offspring are het for diffusion, the males tend to show more influence from the diffusion gene. As a result, breeding trials can create indeterminate outcomes if the possibility of either gene has not been eliminated from the parents.

It is possible that high-end “bloodred” specimens are actually a combination of both the masque and the diffusion morphs, which could explain why so many hets for diffusion (especially males) show the above phenotype. But it will likely take several years before any such determination could be made.

Short-tail mutant:

The phenotype produced by this gene is a shortened tail, which can look "stubby" compared to normal corns. Breeding trials have produced three generations of these snakes and shown that it is either a dominant or semidominant mutant. A short-tail X short-tail breeding trial was done in 2008, producing 15 eggs with no obvious signs of a lethal or catastrophic effect on offspring.

Affected snakes generally have some small, palpable lumps (kinked/fused vertebrae) in the tail which may or may not be visible. The gene appears to have no effect on the health or vigor of the snake. These are not highly angular kinks or corkscrews, some specimens are difficult to detect since the "lumps" can be extremely subtle or nonexistent when viewing or feeling the tail. It should be noted that none of these specimens have shown any signs of spinal deformity in the lumbar or thoracic vertebrae. This mutant has only been shown to affect the caudal vertebrae, which are in the tail, and appears to be purely cosmetic.

Radiographs (x-rays) were taken of the spines of normal and short-tail corns. The differences are shown below.

Depiction of the tail vertebrae of normal (above) and short-tail (below)

Several genes producing similar phenotypes are known in mammals including dogs, cats, and mice. In some cases these are widespread and considered to be "normal" for a particular breed.

Since this gene is not recessive, anyone wishing to remove it from their colony or avoid bringing it into their colony can simply not purchase, or not breed, any snakes showing this phenotype. It should be noted that, like all dominant and codominant genes, unaffected snakes that are siblings to short-tails, or offspring of short-tails, are **not** carrying this gene.

Stargazer mutant:

Stargazing in corns is a neurologic condition that seems to be inheritable as a simple-recessive gene. It results in a neurologic condition which affects the snake's ability to move correctly. At rest they appear normal. But when stimulated to move, they show uncoordinated, jerky movements with a loss of fine motor control. The more focused they are on a goal the more uncoordinated they become. Dr. Connie Hurley has noted that this seems to be very similar to cerebellar hypoplasia in mammals (lack of development of the cerebellum of the brain), which causes loss of fine motor control, uncoordinated gaits, and intention tremors (which worsens the more they concentrate on something.)

While the snake is crawling, its head may weave back and forth or even flip back, giving the characteristic "star gazing" appearance for which they are named. Some may even crawl upside down or backwards. Mentally, they appear to be normal, and eat, drink, eliminate, hide, and breed just like a normal corn snake. They also respond normally to stimuli such as getting excited when they smell food, or striking and fleeing when feeling threatened. They don't appear distressed or in any pain from the condition.

Since this gene is not dominant or codominant, it may be difficult to remove from a colony, especially without pedigrees. Breeding trials using known carriers would be required to verify any snake as a non-carrier. Avoiding inbreeding may keep the gene from being paired up and thus expressed within the direct progeny, but this is only a short-term solution. Unfortunately this practice will result in the gene being unknowingly propagated (in the form of "50% possible hets") throughout the entire corn population until many unrelated snakes become carriers. In the future, even random outcrossings between different morphs will be able to produce stargazers, the way amelanism does today. The only way to avoid propagating this (or any recessive) gene is through proving future breeders as non-carriers before their offspring are allowed to enter the gene pool. In order to do this, known carriers of the gene (also called "*S-factored*") are needed to test suspect animals and eliminate them from the breeding program.

Additional Morphs

Counting only the possible genetic combinations, and ignoring all the selectively bred variations, there are over 100,000 possible morphs. Following are some of the triple combinations, quad combinations, and other variations that don't quite fit the simpler classifications. Red-removal (anery, caramel, charcoal, lavender) plus black reduction (ultramel, hypo, lava, sunkissed) plus pattern alteration (motley, striped, diffused) is currently a very popular formula for creating new genetic combos. The cinders, kastanies, dilutes, terrazzos, and tesseras offer yet another set of branches.

+Dilute
+Anerythrism
+Stripe

Photo by Susan Willis - Willis Wildlife Enterprises

+Hypomelanism
+Lavender
+Stripe

Photo by Sean Niland – VMS Professional Herpetoculture

+Amelanism
+Lavender
+Stripe

Photo by Sean Niland – VMS Professional Herpetoculture

+Hypomelanism
+Charcoal
+Motley

Photo by Sean Niland – VMS Professional Herpetoculture

+Hypomelanism
+Charcoal
+Diffusion

Photo by Charles Pritzel - CCCorns

+Hypomelanism
+Charcoal
+Stripe

Photo by Jeff Mohr- Mohrsnakes

+Amelanism
+Anerythrism
+Motley

Photo by Charles Pritzel - CCCorns

+Lavender
+Anerythrism
+Motley

Photo by Charles Pritzel - CCCorns

+Caramel
+Anerythrism
+Motley

Photo by Arjan Coenen – Corns.nl

+Hypomelanism
+Anerythrism
+Caramel
+Stripe

Photo by Jeff Mohr- Mohrsnakes

+Lavender
+Anerythrism
+Amelanism

Photo by Sean Niland – VMS Professional Herpetoculture

+Amelanism
+Anerythrism
+green/yellow variation of blotches

Photo by Hessel Duijff

+Amelanism
+Diffusion
+Motley

Photo by Arjan Coenen – Corns.nl

+Amelanism
+Diffusion
+Stripe
+Cubed variation of stripe pattern

Photo by Arjan Coenen – Corns.nl

Hybrids and Intergrades

Breeding cornsnakes to many other species of North American snakes has produced hybrids and intergrades. The two most common crosses are with Emoryi ratsnakes, and California kingsnakes.

Creamsicle ($40-80)

This term has two meanings:

- It is generically applied to any corn/emoryi cross to denote that it carries emoryi blood.
- It is specifically applied to amelanistic corn/emoryi individuals. The pictured example is amelanistic.

Photo by Don Soderberg–
South Mountain Reptiles

Creamsicle projects are started by crossing an amel cornsnake to an emoryi ("great plains") ratsnake. These offspring are then either bred to each other, or to an amelanistic cornsnake. In the second generation and beyond, the amelanistic offspring (or any amel with an emoryi ancestor) are called creamsicles.

The name is a great description of their colors. They can have varying amounts of cornsnake versus emoryi blood, depending on whether they have been bred back to cornsnakes or to emoryi. The colors tend more toward red as more cornsnake is bred into the lines, and more yellow as more emoryi is bred into the lines.

Rootbeer ($ 40-50)
This name has more recently caught on as a name for corn/emoryi crosses that are not expressing any genetic traits. Several other traits, including hypo and motley, have been bred into these intergrades.

Cinnamon ($30-45)

This name has been more frequently used to describe corn/emoryi crosses that are expressing the hypo trait. They have also been referred to as “hyposicles.”

Jungle Corn ($???, *varies greatly*)

This name is applied to crosses between cornsnakes and California kingsnakes. These are **not** typically sterile, but it appears that they are not quite as fertile as either parent species. Second generation offspring (and beyond) have been produced from these hybrids. Amel, snow, motley, and other varieties of jungle corns are known to exist.

Pueblocorn ($???)

The name pueblocorn is applied to hybrid crosses between cornsnakes and pueblan milksnakes. The patterns can vary from corn to pueblan to everything between. This specimen is anerythristic and has a more pueblan-like banded pattern.

Other crosses have been made that include milksnakes, gopher snakes, bull snakes, and other North American colubrids. Corn X Honduran crosses are known as *corndurans*. Corn X gopher crosses are referred to as *turbo corns*.

Coming Attractions

Many claims of "new" morphs are made each year. Almost all of them quickly disappear and are never heard of again.

If a "new" morph is based on a proven genetic trait, it will catch on sooner or later. The name coined by the originator/discoverer will often stick, but sometimes a different name will become more popular.

If a "new" morph is based on a selectively bred variation of an existing morph, enough people have to believe it is distinctive from existing variations that they will accept it as "new" and use the suggested name, earning it a place in the market and among hobbyists.

Some odd appearances are currently being investigated by different breeders, and could prove genetic within the next few years…

- **Unnamed mostly white mutant** – One of these is in captivity and the owner is planning to breed it to see if it is genetic. Apparently another specimen was seen in the wild in the same area. This is a good sign that the trait could be heritable. The effect seems similar to the merle/paint/splash/pied mutants in many species. If this look proves genetic it will probably generate as much excitement as the pied-sided morph did a few years ago.

- **Blushing Corns** are expected to reach the market this year. The genetic makeup is currently a trade secret.

Photo by Sean Niland – VMS Professional Herpetoculture

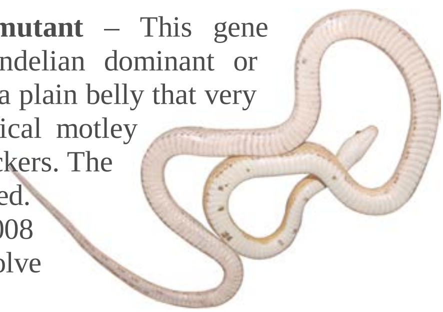
- **Strawberry** – Initially considered a "hypo-like" trait, it appears that this may instead be an allele to standard hypo with different expression. Further breeding trials should help to sort out its nature.

- **Christmas** – Another potential hypo-like gene, these have been proven as simple recessive. Test-crosses against other known "hypo-like" genes are still needed before it is known if this is a new gene or one of the previously known mutants.

- **"Piebald"** – Also called *pied*, this trait replaces random patches of the snake's normal pattern with solid white. Although pied-sided has been proven as a genetic trait, a more familiar form has not yet been found in cornsnakes.

- **"Leucistic"** – A patternless white snake. This trait, like piebald, exists in many species and will inevitably show up in cornsnakes. However, leucism is also being brought into the cornsnake gene pool by hybridization with leucistic black ratsnakes and leucistic Texas ratsnakes.

- **Unnamed plain belly mutant** – This gene appears to act as a Mendelian dominant or codominant gene, causing a plain belly that very closely resembles the typical motley belly, plus a few stray checkers. The dorsal pattern is not affected. Breeding trials from 2008 and 2009 may finally solve this puzzle.



- **"Wide Stripe"** – Several breeders are trying to determine the mode of inheritance of this aberrant pattern. So far it has shown it is not controlled by a simple dominant or codominant gene.

- Another similar looking aztec or wide-stripe pattern appears to be controlled by a simple codominant gene.

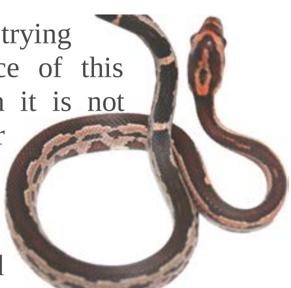
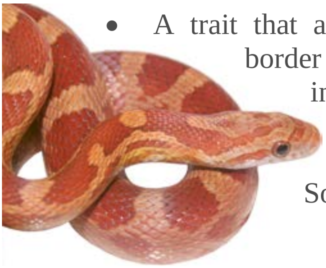


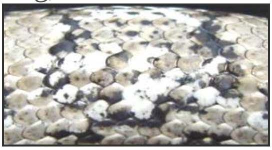
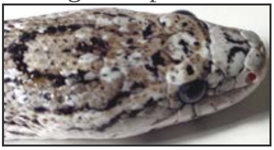
Photo by Jeff Mohr – Mohrsnakes



- A trait that appears to have a hypo-like and/or border reducing effect is being investigated. This is commonly found in keys/rosy corns but has never been put through breeding trials. Some tests could happen in 2009.

- **Golden Okeetee** – An odd corn with very little red and a lot of yellow coloration—similar to but not necessarily the same as caramel corns—was caught in the wild in North Carolina. Breeding trials to determine its heritability began in 2005. The gene proved recessive in 2006 when similar offspring were recovered in the F2. The other remaining test is to cross one against a caramel.

- **Snowflake** – The white spotting appears to be heritable as a mendelian recessive. This white spotting is not present at hatching, but comes in later as the snakes grow up.

Photos by Sean Niland – VMS Professional Herpetoculture

- **"Paradox Albino"** – Some amelanistic cornsnakes have some black areas. This is unexpected on an amelanistic cornsnake, but in some individuals it happens. Hence the name "paradox." Pictured here is a snow with black spots on it.

Photo by Sean Niland – VMS Professional Herpetoculture

People are always searching for new traits. This is an exciting process, but problems can occur when it is assumed that all unusual appearances are caused by genetic traits. Here are some scenarios:

- An odd hatchling or hatchlings come from normal parents, and a breeder assumes it is a recessive trait and both parents are hets. The siblings not showing this “trait” are then labeled as “possible het” and sold at a premium.

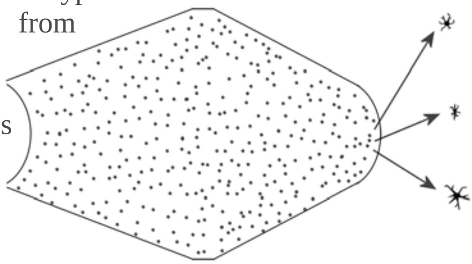
- A breeder has a name applied to a line of selectively bred corns. A buyer or reseller who isn’t familiar with the name then sells the individual(s) with the name attached. The next person assumes it is a genetic trait and sells offspring as “hets.”

The problem is that the above scenarios are based on the assumption that anything with a name, or anything odd or unusual, is genetic. This is **not** a safe assumption, since many cornsnakes hatch out with odd patterns or colors due to any number of non-genetic causes. Unusual incubation conditions appear to be the most common cause.

In order for a trait to be proven genetic, it must be reproducible in some predictable way. The required breeding trials can take several years from the time the first specimen is discovered. A simple rule to go by is: *without grandchildren expressing the same look, it cannot be assumed to be a simple genetic trait.* For more details see the Proving Mendelian Genes chapter.

Hypermacro Morph Identification

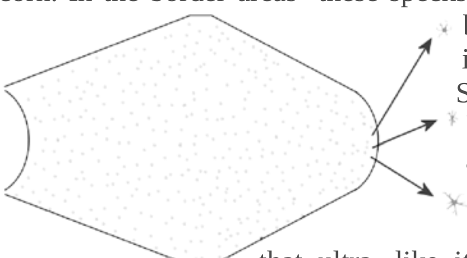
Upon close examination of scales on various corns, one can see tiny black specks present on normal corns, These are absent on amelanistic corns, which suggests they contain melanin. Since each speck can be seen individually with extreme magnification, it was hypothesized that the different hypo-like morphs could result from different modifications to this scheme, and that some of these differences might be visible at this magnification level.



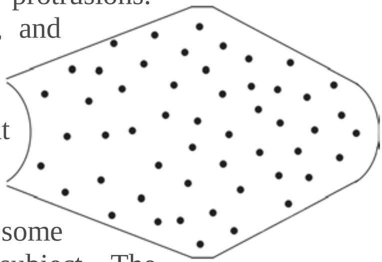
The specks are normally shaped like 'splat' marks.

For example, one way to make a corn look like a hypomelanistic is to have the same number of black specks but each of a lighter color. Another way is to leave the color alone and spread them out, so there is a smaller number of the specks. If these differences could be observed, it would be possible to make accurate morph identifications without breeding trials.

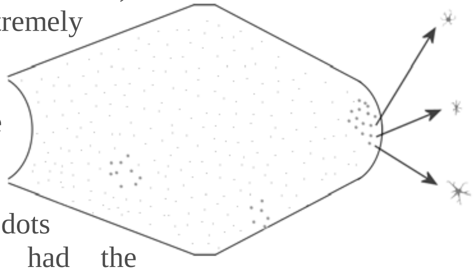
With this hypothesis in hand, normal, hypo, and ultramel corns were observed at 100X and 250X magnification. There was no obvious difference in the speck count, shape, or darkness between normal and hypo corns, but there were no visible specks on the ultramel corn. In the border areas these specks are visible on the ultramel, but they are a very light gray instead of opaque black. Since only one ultramel has been observed, confirmation and further observation is needed. However, this is consistent with the idea that ultra, like its allele amelanism, should affect the *color* of melanin and not its location. Therefore, this is likely to be a dependable method of identifying ultra and ultramel corns, and may prove to be useful in sorting ultramels from ultras.



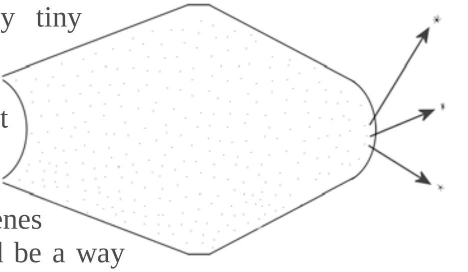
The same inspection of sunkissed corns revealed that the splotches are circular without any visible protrusions. They are also larger than typical, and there is more distance between each one. The shapes are easier to identify at higher magnification, but it can be difficult to see when the specimen is only in focus for a fraction of a second, so it may take some practice learning to steady the subject. The splotches on dilute corns looked very similar to sunkisseds.



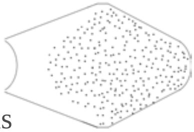
Lava also appears to be easily identified with a hypermacro inspection. In the three lavas observed, the dots were missing (or extremely tiny) across all but small patches of the ground area. In the saddle areas the patches containing dots were more frequent and larger. The shapes of the dots were normal, but they had the appearance of being buried underneath a layer of plexiglass.



Strawberry corns had very tiny spots that were sometimes visible. This depended on conditions, and they might be invisible in conditions of lesser magnification or clarity. Since these two genes behave as alleles, this could be a way to separate strawberry from hypo lines. Het hypo/strawberry is another item which might be identifiable upon closer examination.



In several specimens the splotches only reached most of the way across each scale, and there was an empty area at the front end of each scale, where the neighboring scales would overlap it. This was



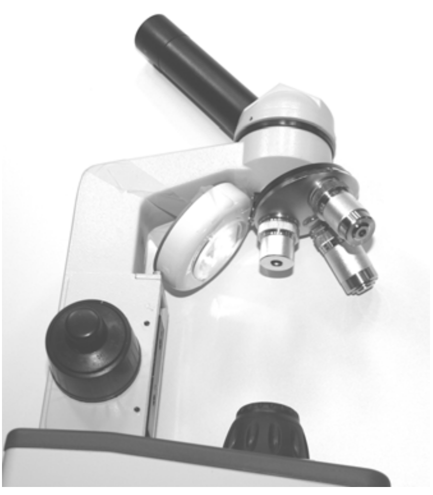
seen in several different morphs from various bloodlines so it is probably not associated with any currently known color or pattern gene, but it seemed at first glance to run in family lines.

Charcoal and anery were also examined. No obvious differences between those two were noticed at the time. Lavenders did have smaller splotches with few to no protrusions, so be mindful of this if you are trying to determine whether a lavender is a hypo, lava, dilute, etc.

Other morphs such as caramel, cinder, diffusion, motley, etc can be interesting to look at with this method, but no distinctive characteristics were found for any of these genes, at first glance, and since it is generally not an issue trying to identify which snakes are expressing these genes, they were not examined as thoroughly.

With many other sets of eyes looking at corns snakes in this way, it is likely that other such differences between morphs will be noticed in the future. It is also possible that hets for particular genes are visibly different under this type of examination, which would eliminate "possible hets" for that gene and help breeders skip test crosses in order to speed up their projects.

The technique for this is simple and inexpensive, so any hobbyist or breeder should be able to use it. You will need a microscope or loupe which can be used at approximately 100X, a bright light shining on the snake from above or the side, and a model for comparison depending on which morph you are trying to identify. Be sure your scope has a setting of approximately 100-200X. Higher magnifications make for an extremely jittery view and it becomes impossible to see anything this way.



There are many brands of cheap microscopes for children available at departments stores for as little as $20. Radio Shack has an illuminated mini microscope (model# MM-100 catalog# 63-1313) for about $12 which does a very good job and is pictured here. A cheaper $6 illuminated 60X-100X scope was also tried but it was unable to focus well enough to see any details with reasonable clarity, and is not recommended for this purpose. The advantage of a microscope with a larger objective lens is that you get a larger field of view, and a more expensive scope with better optics will be able to focus more sharply. The above microscope shows an entire scale whereas the mini microscope shows only about a quarter of that amount.

Hold the snake under the lens and use your hand to move the snake so that it comes into focus. If you are using a microscope with a snake who will sit still, you can rest a coil on the plate where you normally put the glass slides, and then use the focus wheel. Since the snake is round and its scales are curved, only a small area will be in focus at any time. The higher your magnification, the smaller your area of focus will be, so this is another reason to keep the magnification level low.

Keep in mind that the above observations were based on a small sample of anywhere from two to a dozen specmens. They are not being presented here as absolute rules of which characteristics define which morphs. Instead, they are a starting point from which further observations can be used to assemble a useful technique that any cornsnake hobbyist can learn to use. There will probably be updates and revisions to the technique as new information is gathered. Updates will be tracked at http://cornguide.com.

As with popping, probing, and palpating for eggs, it is necessary to gain a feel for the differences between snakes before relying on this method for identifying different morphs. There seems to be as much variation between snakes on this scale as there is on the visible scale, so be sure to view multiple examples of various morphs to see if the characteristic you have observed does occur consistently on that morph, or if it is just particular to that snake.

Projects And Experiments

In past years, hobbyists have cooperated in breeding trials as well as other experiments and projects. Often, if not always, the only way to answer many questions we have is for individual hobbyists to experiment themselves and report their results. Examples of past experiments have included things like cutting the skin on thawed mice to see if digestion is improved, and supplementing with beta-carotene to see if colors are enhanced.

Are they codominant?

Two questions, both of which could easily be answered by a hobbyist willing to experiment, repeatedly come up. Is the hypo gene codominant? That is, can it be detected in hets using only the naked eye? The same question can be applied to the caramel gene. A simple experiment can answer both these questions. It doesn't require expertise, just time and patience. Here is how it works:
1-Breed a known het for caramel to a known non-het for caramel. (This makes all of them 50% poss hets.)
2-Raise the entire clutch.
3-At hatching, 3 months, 6 months, 1 year, and when you first breed them, look at the hatchlings with your own eyes and guess whether or not you think that individual is het. Write down your guesses.
4-Perform breeding trials on all of these individuals to find whether or not they are het for caramel.
5-Compare the actual results with your guesses and report the results to the hobbyist community.

If you were very accurate in predicting which were het and not het, and it was a sample of 10-12 or more hatchlings, this would make a very compelling argument for caramel being codominant. Other hobbyists would be able to rely on this method of identification in caramel hets, and they would often gratefully point to the results of the [your name] experiment as evidence.

Artificial Insemination

This has already been done in snakes, and at least one or two zoos have successfully bred cornsnakes through AI. Our effort will be to devise a technique hobbyists can use, which can be learned as easily as popping or probing. Hobbyists would be able to collect sperm, evaluate, store, ship, and inseminate with it. This would make cooperative breeding much easier; a single male could sire offspring from around the world. Breeding loans could be arranged without the risk or expense of shipping an adult snake. It can also help breeders with smaller colonies to avoid inbreeding.

This year several techniques for collection will be investigated. The simplest is just to scoop up spilled semen at the end of a breeding, and this has already proven effective. Other methods involve fooling the snake into thinking it is breeding either manually or with an “artificial vent,” or forcing the sperm through the vas deferens and collecting it at the vent, a procedure known as “stripping.”

Evaluation involves putting a sample under a microscope to check for viable sperm cells or "swimmers." This can easily be done by anyone with a $20 microscope. Swimming sperm can easily be observed at magnifications as low as 250X and 400X. This is more important for semen that has been shipped, and it is more a matter of satisfying our desire to find out as soon as possible if the sperm are viable. If they are not, you will find out about a month later when there are either slugs or no eggs.

Long term storage may prove more difficult, and although it is not absolutely necessary, it could help breeders who brumate at different times and could also allow breeding a male long after he has died. Storage techniques will probably be the last to be perfected and may take some time.

Shipping is the second trickiest step, as sperm can be sensitive to many different conditions. However, this will be necessary for cross-collection breedings, which would be the main benefit of the AI project.

Insemination consists of detecting when the female is ovulating and then placing the sample inside her cloaca. Both of these skills are already common among hobbyists who can probe and palpate their corns, so this step may be as easy as collecting the semen.

Again, the ultimate goal of this project is to make it so easy that any hobbyist could use AI to breed their corns.

Proving Mendelian Genes

Proving a gene as Mendelian (recessive, codominant, or dominant) is a great tool for morphing our corns and can add value to carriers of a gene, because it allows the new characteristic to be combined into the hundreds of existing morphs with predictable results. But the process can be a bit difficult to understand.

The first step is deciding if a trait or characteristic is interesting enough to try to prove it out. It can be anything you want, such as eye color, shapes of scales, speckled or smooth colors, elongated head, etc. It might also be a negative trait that people want to remove from their gene pools. If it is recessive, simply getting rid of affected individuals will only temporarily hide the problem and will make it much more difficult to deal with when it returns.

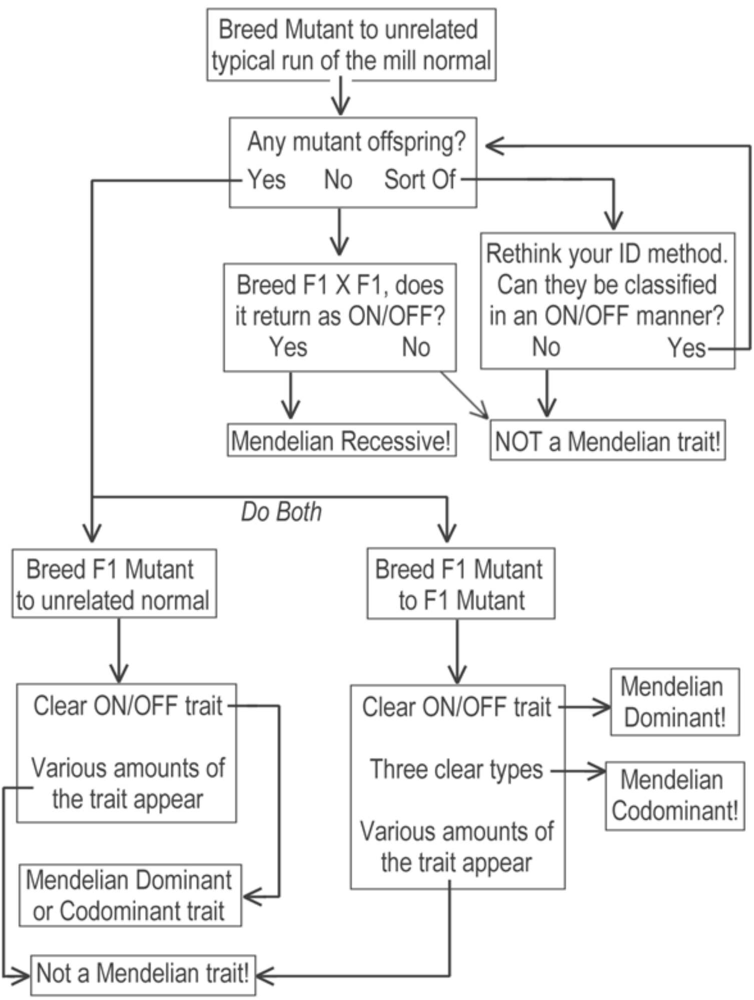
Next you need to locate a suitable mate. It is absolutely vital to choose a mate whose offspring will not mask the expression of whatever trait you are looking for, and whose offspring will not mimic the expression of that characteristic. For example, say you have found a snake with huge saddles and wish to find out if this is inherited in mendelian fashion. If you cross it to the largest-saddled snake you can find, even if the offspring have large saddles, you have no way of knowing which parent(s) contributed to that look. Conversely, if you cross it to a carrier of a patternless gene or a snake with unusually small saddles, you won't be able to tell if the saddles have been affected.

The ideal mate is a run of the mill, typical snake, or one that is expressing pattern or color genes which won't interfere with your ability to classify your hatchlings. For example, testing the motley gene can be done by crossing to a normal, a snow, a lavender, a butter, a phantom, or most other color morphs.

Once a suitable mate has been selected, you are ready to begin breeding trials. Know beforehand that you will need to produce grandchildren in order to prove an inheritance pattern. Use the following flow chart to work out your results.

When evaluating mutant or non-mutant, there should be little or no "between" states. The difference should be a very clear and easily-classified yes or no. For example, if you tried to identify motleys by counting the number of connected saddles, the results would not be very clear and you might think it is a selectively bred trait. Meanwhile if you instead use the obvious yes/no belly pattern as the indicator, you can discover its mendelian recessive mode of inheritance quite easily.

Keep this in mind, and the possibility that what you consider “a trait” could be a complex of independent traits. You might need to rethink how you identify mutant versus non-mutant. This is most common in new wild-caught specimens, and can cause confusion when the breeder hangs on to the idea that the entire look of the snake is “a trait.”



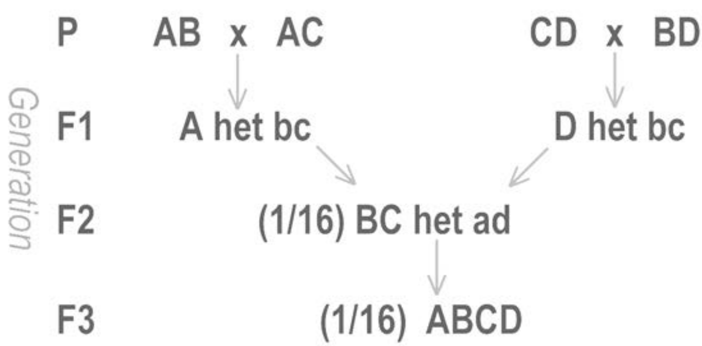
Breeding Schemes

Double and triple genetic morphs are becoming more and more common. A few quadruple morphs are being produced, too. Many times these are produced by the brute force method of producing triple or quad hets and then keeping back large quantities to overwhelm the odds. This technique can be useful if you are willing and able to keep large numbers of snakes, or if you only want to dedicate your efforts toward a single project.

Following is a method which takes advantage of the current gene pool and clutch sizes, doesn't require the keeping of such large numbers of snakes, and allows diversification of projects. It can be used as is, or as a starting point for additional schemes to roll over genes into new combinations.

Imaginary recessive genes **A** through **D** will be used for this example. Say you want to produce a snake expressing all four genes (of morph **ABCD**) but they currently only exist as single morphs and double combinations. (**AB** and **BD** and **BC**, etc)

Overview

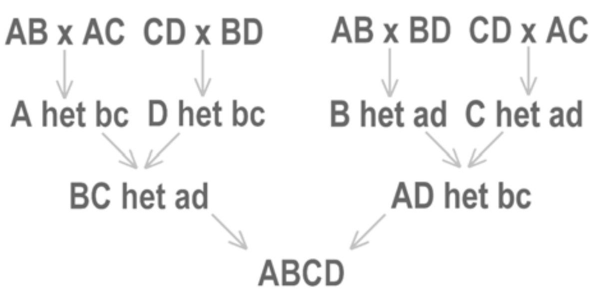


(P) Start out with double morphs. Crossing these (P) together in the right way produces (F1) snakes expressing one morph, and het for two others. Taking two separate lines of these (F1) with matching hets, you will then recover the hets while outcrossing the homos. Then you will have (F2) snakes homo for two morphs and het for two more, which you can use to produce your (F3) quad morphs.

The first advantage in this process is that you do not have to go beyond 1 in 16 odds. This is important, because it is not overly difficult or time-consuming, and does not require you to raise up and breed large numbers of snakes for a single project. You can defeat higher odds (1 in 64, for example) with larger groups, but then you end up producing many more normal and other common morphs, and you are left with less room for other projects.

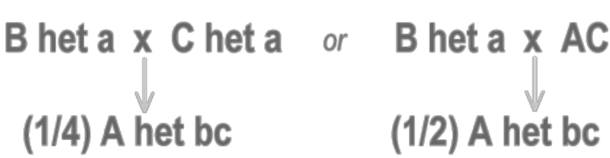
The next advantage is that this system allows you to overlap the F1 and F2 from various projects, so that you can produce even more variety by intermixing different lines. For example if you also have a project involving gene E, you might have **E het bc** to go with **A het bc**, which can be a shortcut to a project producing **ABCE** corns.

These snakes are also found in triple morph projects, for example when someone crosses a hypo lavender to a lavender motley, they produce lavenders het hypo motley. Watch for these genotypes, you might be able to find them for sale and skip the first generation.



Next, this plan can be expanded by swapping the mates from original crosses on the next year. In addition to producing **A het bc** and **D het bc**, you can also produce **C het ad** and **B het ad**. This has the advantage of producing all known hets in the final generation, where the simpler plan produces 66% possible hets.

Another potential shortcut is available if you cannot find the double morph you need to start out with. For example if you want to cross **AB** to **AC** in order to produce **A het bc**, you can also drop the overlapping gene to a het in one or both mates. Your resulting clutch will not consist entirely of the desired offspring, but you don't need an entire clutch of them.



Finally, this plan can be used cooperatively between breeders. Different people can raise up and exchange counterparts along the way. If the different breeders use different stock for their starting point, there will be no inbreeding, which can help maintain the vigor of a bloodline. Cooperation also allows again for more projects to be run simultaneously, or for more individuals to be kept as a way to increase your chances of success.

An online calculator is available on the cornguide.com website, (**http://cornguide.com/quads.php**) where you can fill in the four genes you wish to combine, check which combinations are available, and apply them to this plan.

You might find it easier to design your own such plan given what you have available to work with. When manipulating the plan, be sure to keep in mind that the advantage is gained through rolling over the double hets. The reason is that recovering Mendelian traits in this way gives a 1 in 16 chance per egg. It is reasonable to expect some success with a small number of clutches or even a single clutch. With those odds and a clutch of 16 eggs, you are about twice as likely to succeed as you are to fail.

The same rollover technique works on double hets whether they are single morphed, or even double or triple morphed, as long as the double hets are the same in both mates.

Appendix A – Further Reading / Hyperlinks

A support website for this book is located at **http://cornguide.com.** A forum linked from the site allows readers to communicate with each other and the author with questions, comments, and feedback about this guide. An online genetics tutorial is there, too.

Online forums, where you can have a dialogue with other cornsnakers, and browse an ever-growing gallery of cornsnakes, are located at: **http://cornsnakesource.com**

Several handy programs (for Windows) that predict the outcomes of morph breedings exist. Three of them are on the web:
http://mywebpages.comcast.net/spencer62/cornprog.html
http://www.kornnatterlexikon.de
http://www.cornsnakes.nl/

Genetics For Herpers, by Charles Pritzel is recommended to readers of the Cornsnake Morph Guide who want to learn and understand Mendelian genetics.

The Corn Snake Manual, by Bill and Kathy Love contains a great deal of information about caring for and breeding cornsnakes, and historical information about the origins of many of the morphs, along with a lot of quality photos. It can be found at many bookstores and reptile shows, or you can order it online directly from the authors at: **http://cornutopia.com**

The second edition of the Corn Snake Manual, also by Kathy Love and Bill Love, is titled Corn Snakes The Comprehensive Owner's Guide and is also available (signed by the authors) at Kathy Love's cornutopia.com website.

Corn Snakes In Captivity by Don Soderberg was just released in October of 2006. **http://www.cornsnake.NET**

A Color Guide to Corn Snakes by Michael McEachern is an old but useful book. It can be found at amazon.com.

A web search for cornsnakes will bring up a lot of breeders' sites. Many of them have pictures and information about the morphs they produce and sell. This is a good way to become familiar with the names and looks and varieties. The following websites are a good starting point:

http://cornsnakesource.com has Photo and Progression Galleries. *A progression follows a single snake as it grows up so you can see the colors change over the years.*

http://www.serpwidgets.com/Morphs/morphs.html

http://herpregistry.com/acr

http://cccorns.com/collection2009.php

http://cornsnake.NET/ (Both the price list and the photo gallery)

http://cornutopia.com

http://vmsherp.com/

http://corns.nl

http://www.morphgallery.com

http://www.iansvivarium.com/cornmorphs.html

A list of links will be maintained at http://cornguide.com.

Appendix B – Prices and Frequency of Morphs

Frequency of single and double genetic morphs:

	Amel	*Ultra*	*Hypo*	*Sunkissed*	*Lava*	*Anery*	*Charcoal*	*Caramel*	*Lavender*	*Diffused*	*Motley*	*Stripe*	*Cinder*	*Dilute*
Amel	C	U	*	r	r	C	C	C	C	U	C	C	r	
Ultra	U	U	?	r		r	r	U	r	r	U	r		
Hypo	*	?	C	r	r	C	C	C	C	U	U	U		
Sun	r	r	r	U	r	r	r	r	r		r	r		
Lava	r		r	r	U	U	r	r	r	r	r			
Aner	C	r	C	r	U	C	*	U	U	U	C	C		U
Char	C	r	C	r	r	*	C		r	U	r	r		r
Crml	C	U	C	r	r	U		C	r	U	U	U		
Lvnd	C	r	C	r	r	U	r	r	C	U	U	r		
Diff	U	r	U		r	U	U	U	U	C	r	r		
Mot	C	U	U	r	r	C	r	U	U	r	C	U		
Strp	C	r	U	r		C	r	U	r	r	U	C		
Cind	r												r	
Dlt						U	r							r

Key:

C	Common *(Easy to find and purchase)*
U	Uncommon *(May be difficult to find and purchase)*
R	Rare *(A handful or fewer specimens exist)*
	Not known to exist
*	Probably common, but very few specimens identified.

***About the "Common Price Index" for morphs*:** This guide includes a "price range" for each morph. The listed prices are included to give the reader a general idea of the current market prices of different morphs. They are calculated using a complex formula designed to determine a reasonable "ballpark" range. By no means are they a suggested price, nor are they necessarily the average.

Note that the prices are based on hatchlings. Lone females are often sold at 10% to 25% more than the cost of a single male because breeders find it more difficult to sell off remaining unpaired males.

Adults and juveniles are usually a lot more expensive than hatchlings, since they will be able to breed sooner. Proven breeders (snakes that have already produced offspring) are even more valuable.

All cornsnakes of the same morph are **not** created equal. Variations in price are based on factors such as:

- how common they are
- how difficult they are to produce
- how popular they are
- local availability
- the quality/distinctiveness of an individual breeder's bloodline(s) compared to other bloodlines of the same morph
- being het for additional genetic traits

Many morphs can vary wildly in price, in some cases more than twice as much as others of the same morph. Trying to quote prices is like trying to predict the weather six months in advance, so take these numbers with a large grain of salt.

Finding the same morph for a lower price is not necessarily a better bargain… you tend to get what you pay for. Do not assume that any price above the listed range is overpriced. All cornsnakes are unique, and there may be a very good reason for the higher price tag. If you are getting a cornsnake with the intention of breeding it, keep in mind when considering the price tag that this snake's characteristics will influence the offspring it produces, possibly for generations to come. A few dollars difference may not be such a bargain in that light.

Prices of single and double genetic morphs:

	Amel	Ultra	Hypo	Sun	Lava	Aner	Char	Crml	Lvnd	Diff	Mot	Strp	Cind	Dlt
Amel	20-40	50-90	40-60			25-50	50-80	35-70	60-100	100-150	25-50	50-65		
Ultra	50-90	50-90				100		75-125			70-100			
Hypo	40-60		20-40	+++		30-50	50-70	50-80	100-125	80-125	35-70	60-100		
Sunkissed			+++	50-75										
Lava					70-100	150-200			+++					
Anery	25-50	100	30-50		150-200	20-30		50-80	80-100	75-125	35-70	50-65		150
Charcoal	50-80		50-70				30-40			100-125				
Caramel	35-70	75-125	50-80			50-80		20-40		+++	40-65	95-175		
Lavender	60-100		100-125		+++	80-100			60-100	150-250	60-120	+++		
Diffused	100-150		80-125			75-125	100-125	+++	150-250	50-90		+++		
Motley	25-50	70-100	35-70			35-70		40-65	60-120		30-40	30-60		
Stripe	50-65		60-100			50-65		95-175	+++	+++	30-60	35-50		
Cinder													+++	
Dilute						150								150

+++ *Price very high and could vary between breeders and throughout the season.*

Prices of Other Morphs:

Triple Morphs	*Price*	*Genetic makeup:*
Avalanche	125-175	Amel Anery Diffused
Snow Motley	40-60	Amel Anery Motley
Striped Snow	50-90	Amel Anery Striped
Butter Motley	50-80	Amel Caramel Motley
Striped Butter	150-250	Amel Caramel Striped
Whiteout	200	Amel Charcoal Diffused
Hypo Snow	75-100	Amel Hypo Anery
Diffused Opal	+++	Amel Lavender Diffused
Opal Motley	125-175	Amel Lavender Motley
Opal Striped	+++	Amel Lavender Striped
Dilute Anery Motley	150	Anery Motley Dilute
Ghost Motley	40-60	Hypo Anery Motley
Striped Ghost	65-90	Hypo Anery Striped
Hypo Granite	175-250	Hypo Anery Diffused
Hypo Pewter	150-250	Hypo Charcoal Diffused
Hypo Plasma	+++	Hypo Lavender Diffused
Hypo Lavender Motley	+++	Hypo Lavender Motley
Striped Hypo Lavender	+++	Hypo Lavender Striped
Golddust Motley	125-225	Ultramel Caramel Motley

Corn-Emoryi hybrids	
Creamsicle	40-80
Rootbeer	40-50
Cinnamon	30-45
Striped Creamsicle	75-150

Variations of amels	
Candycane	50-70
Reverse Okeetee	40-75
Sunglow	40-60

Variations of normals	
Okeetee	30-70
Miami	25-40
Upper keys / Rosy Rat	30-50
Zigzag/aztec	40-70
Banded	50-80
Milksnake Phase	40-80
Kisatchie	40-60

Selectively bred submorphs	
Crimson	40-70
Hypo Miami	25-100
Hypo Okeetee	40-80
Sunglow Motley	75-125
Pin-striped / Q-tipped Motley	40-75
Bloodred	60-120

Appendix C – Glossary

Allele – Any of the variants that can occur at a given locus. See also: *gene*.

Amelanistic – A condition of having no melanin. See also: *melanin.*

Anerythristic – A condition of having no erythrin. See also: *erythrin.*

Autosomal – A locus that is found on paired chromosomes, as opposed to the sex chromosomes. Loci are assumed autosomal unless otherwise stated. See also: *Mendelian.*

Codominant – A relationship between two alleles where both are expressed when they are heterozygous together. When a codominant/codominant pair of alleles are shown in all three configurations, there are three resulting phenotypes.

Cross Multiply – A method of determining the four possible outcomes of a cross at a single locus. See also: *Punnett square, FOIL.*

Diploid – A cell that contains chromosomes in pairs. Almost all cells in an animal's body are diploid. See also: *haploid.*

Dominant – A gene that, when present in a pair, is the only one expressed. When a dominant/recessive pair of alleles are shown in all three configurations, the dominant allele completely controls the phenotype where it is present. See also: *recessive.*

Erythrin – The red pigment in cornsnakes. See also: *anerythristic*.

FOIL – A method of determining the four possible outcomes of a cross at a single locus. See also: *cross multiply*, *Punnett square.*

Gene – A term that can be used interchangeably with locus or allele. Its meaning depends on the context of its use. See also: *locus*, *allele.*

Genome – One complete set of chromosomes. An individual animal possesses a pair of genomes.

Genotype – The alleles present at a given locus or loci. See also: *phenotype.*

Haploid – A cell that only contains one genome, instead of a pair. Sperm and egg cells are haploid. See also: *Diploid.*

Het – An abbreviation for *heterozygous*.
Heterozygous – Unalike alleles at a locus. It is mutually exclusive to homozygous. See also: *homozygous.*

Homo – An abbreviation for *homozygous*.
Homozygous –Identical alleles at a locus. It is mutually exclusive to heterozygous. See also: *heterozygous.*

Hybrid – Any cross between two unrelated individuals. Most often used to describe crosses between two different species, or members of two different genuses.

Hypomelanistic – When the pigment *melanin* is reduced in quantity or quality. See also: *melanin.*

Incomplete Dominant – A type of codominance: a relationship between two alleles where both are partially expressed when they are heterozygous together. When such a pair of alleles are shown in all three configurations, there are three resulting phenotypes. See also: *codominant.*

Intergrade – 1: a cross between two species or subspecies in the wild. 2: the result of several generations of interbreeding between species or subspecies. 3: a cross between two similar species or subspecies in captivity.

Line Breeding – A type of selective breeding where related individuals are crossed in an effort to fix a trait. See also: *selective breeding.*

Locus – A location, on a particular chromosome, where a particular set of alleles reside. See also: *gene.*

Melanin – A pigment, mainly responsible for the blacks/browns on corns. See also: *amelanistic, hypomelanistic.*

Mendelian – A trait that follows certain expression patterns because it is controlled by a pair of genes, one inherited from each parent. See also: *autosomal.*

Phenotype – The outward appearance (size, shape, color, temperament, etc.) of a specimen. See also: *genotype.*

Possible het – A label used to designate that a specimen has a certain statistical chance of being heterozygous for a particular recessive gene.

Punnett Square – A method of determining the four possible outcomes of a cross at a single locus. The father's first gene is combined with each of the mother's genes, then the father's second gene is combined with each of the mother's genes. See also *cross multiply, FOIL.*

Recessive – An allele that is not expressed when paired with a dominant allele. When a dominant/recessive pair of alleles are shown in all three possible configurations, the recessive allele only controls the phenotype where it is homozygous. See also: *dominant.*

S-factored – Indicates that an individual is a proven carrier of the stargazer mutant.

Selective Breeding – A breeding program where individuals showing a certain look are bred to each other in order to enhance that look. See also: *line breeding.*

Xanthin – A pigment, mainly responsible for yellows on corns.

Zygote – A fertilized egg.

Appendix D – Morph Name Cross-Reference

A

Albino – *See Amelanistic.*
Albino Okeetee – S*ee Reverse Okeetee.*
Amel –*See Amelanistic.*
Amelanistic – Homozygous for amel at the albino locus.
Amelanistic Okeetee – *See Reverse Okeetee.*
Anery – *See Anerythristic.*
Anery A – *See Anerythristic.*
Anery B – *See Charcoal.*
Anerythristic – Homozygous for anery at the anery locus.
Avalanche – Genetic combination of amel & anery & diffused.
Aztec –Selective breeding for pattern involving aberrant angular markings.

B

Banded – Selective breeding for pattern with saddles extend toward belly.
Black Albino – *See Anerythristic.*
Blizzard – Genetic combination of amel & charcoal.
Blood – *See Bloodred.*
Bloodred–Diffused plus selective breeding for borderless and extreme red.
Bullseye – *See Hurricane Motley.*
Butter – Genetic combination of amel & caramel.

C

Candycane – Amelanistic plus selective breeding for white ground color.
Caramel – Homozygous for caramel at the caramel locus.
Charcoal– Homozygous for charcoal at the charcoal locus.
Charcoal Ghost – 1: genetic combination of anery & charcoal & hypo.
2: genetic combination of charcoal & hypo.
Christmas – Unproven hypo-like recessive trait.
Cinder – Homozygous for cinder at the cinder locus.
Cinnamon – Hypomelanistic plus emoryi hybrid.
Circleback Motley – Motley with saddles connecting all the way to the vent, forming circles of ground color.
Coral Snow – 1:genetic combination of amel & anery & hypo.
2: genetic combination of amel & anery, plus selective breeding for extreme coral colors.
Cornduran – Hybrid of corn and Honduran milksnake.
Creamsicle – Amelanistic plus emoryi hybrid.
Crimson – Hypomelanistic plus selective breeding.
Cubed – Striped plus variation/selective breeding for square saddles.

D

Diffused – Homozygous for diffusion at the diffused locus.
Diffused Okeetee – Diffused plus selective breeding for heavy bordering and bright orange ground color.
Donut – *See Hurricane Motley.*
Dream – Hypomelanistic plus selective breeding for Okeetee-like traits.

F

Fire – Genetic combination of amel and diffusion.
Four-lined Stripe – *See Striped.*
Frosted – 1:Selective breeding for dithering/frosting of saddle colors.
2: Denotes hybridization with gray rat snakes.

G

Ghost – Genetic combination of hypo & anery.
Ghost Motley – Genetic combination of hypo & anery & motley.
Golddust – Genetic combination of ultra/ultramel & caramel.
Granite – Genetic combination of anery & diffusion.
Green Blotched Snow – Genetic combination of amel & anery, plus variation/selective breeding for green tinted saddles.

H

Hunt Club – Denotes locality of origin as the Okeetee Hunt Club.
Hurricane Motley - Motley plus selective breeding for faded out saddle interior and boldly outlined saddles.
Hybino – Genetic combination of amel & hypo.
Hypo – *See Hypomelanistic.*
Hypo A – *See Hypomelanistic.*
Hypo Miami – Hypomelanistic plus selective breeding for Miami-phase.
Hypo Okeetee – Hypomelanistic plus selective breeding for Okeetee phase.
Hypomel – *See Hypomelanistic.*
Hypomelanistic – Homozygous for hypo at the hypo locus.

I

Ice – Genetic combination of anery & lava.

J

Jungle – Hybrid of corn and kingsnake, usually California king.

K

Keys – *See Upper Keys.*
Kisatchie– Rat snake Species, also considered intergrade of corn x emoryi.

L

Lava – Homozygous for lava at the lava locus.
Lavamel – Genetic combination of amel & lava.
Lava Okeetee – 1: Lava descended from locality Okeetees. 2:Lava plus selective breeding for Okeetee-like traits.
Lavender – Homozygous for lavender at the lavender locus.
Locality Okeetee – Locality-specific or descended from locality stock, the locality being the Okeetee Hunt Club, or Jasper County, SC.
Look-eetee – *See Okeetee Phase.*

M

Miami – *See Miami Phase.*
Miami Motley – Motley plus selective breeding for Miami-like traits.
Miami Phase – Normal plus selective breeding for a clean light gray (non-orange/tan) ground color.

Milksnake Phase – Normal plus selective breeding for banded saddles and light ground color.
Mocha – *See Lavender.*
Motley – Homozygous for motley at the motley locus.
Motley/striped – 1: Motley plus variation/selective breeding for a pattern with pinstriped, or q-tip markings. 2: Heterozygous for motley and stripe at the motley locus.

N

No-White Amel – Amelanistic plus selective breeding for lack of white saddle areas.
Normal – 1: Not expressing any of the known genes. 2: Having normal coloration. 3: Having normal patterning.

O

Okeetee – 1: S*ee Okeetee Phase*. 2: S*ee Locality Okeetee.*
Okeetee Motley – Motley plus selective breeding for Okeetee-like traits.
Okeetee Phase - Normal plus selective breeding for Okeetee-like traits.
Opal – Genetic combination of amel & lavender.
Orange Candycane - Amelanistic plus selective breeding for white ground color and orange saddles.
Orchid – Genetic combination of sunkissed & lavender.

P

Pastel – Applied in many different ways to anerythristics of many genotypes and breeding. Please refer to individual using it.
Pastel Ghost - Applied in many different ways to anerythristics of many genotypes and breeding. Please refer to individual using it.
Pastel Motley - Applied in many different ways to anerythristics of many genotypes and breeding. Please refer to individual using it.
Patternless – Striped plus selective breeding for stripes that disappear.
Pepper – *See Pewter.*
Pewter – Genetic combination of charcoal & diffusion.
Phantom – Genetic combination of hypo & charcoal.
Pied-sided – Either genetic combination of diffusion & piedsided, or homozygous for piedsided at the diffused locus. (Breeding trials underway)
Pink and Green Snow - Genetic combination of amel & anery, plus variation/selective breeding for green tinted saddle borders, plus either pink ground color and/or pink saddle color.
Pinstriped Motley – Motley plus variation/selective breeding for pinstriping.
Plasma – Genetic combination of lavender & diffusion.
Platinum – Genetic combination of hypo, anery, & charcoal

R

Red Albino – *See Amelanistic.*
Reverse Okeetee - Amelanistic plus selective breeding for thickened border areas and extreme orange ground color.
Rootbeer – Normal plus emoryi hybrid.

Rosacea – Elpahe guttata rosacea. *See Upper Keys.*
Rosy – 1: *See Hypomelanistic.* 2: *See Upper Keys.*
Rosy Ratsnake - *See Upper Keys.*

S

Slowinskii – Pantherophis slowinskii. S*ee Kisatchie.*
Snow – Genetic combination of amel & anery.
Strawberry – Unproven hypo-like trait.
Stripe/Motley – *See Motley/striped.*
Striped – Homozygous for striped at the motley locus.
Striped Motley - *See Motley/striped.*
Sulfur – Genetic combination of amel & caramel & diffusion.
Sunglow – Amelanistic plus selective breeding for no borders and extreme orange ground color.
Sunglow Motley – Genetic combination of amel & motley, plus selective breeding for no borders and extreme orange ground color.
Sunkissed – Homozygous for sunkissed at the sunkissed locus.
Sunkissed Okeetee – Sunkissed plus selective breeding for Okeetee-like traits.
Sunspot – Motley or stripe plus variation/selective breeding for oval-shaped saddles.

T

Terrazzo – Homozygous Terrazzo at its locus.
Tessera – Expressing the tessera pattern. (Genetic testing in progress.)
Topaz – Genetic combination of lava & caramel.
Transparent Hypo – *See Lava.*
True Okeetee – *See Locality Okeetee.*
Turbo – Hybrid of corn and gopher snake.

U

Ultra – Homozygous for ultra at the albino locus.
Ultramel – Heterozygous for ultra and amel at the albino locus.
Upper Keys – Locality-specific, although many of these are descended out of stock from the *lower* Florida Keys.

V

Vanishing Stripe – Striped plus variation/selective breeding for striping that fades out as the snake matures.

W

Whiteout – Genetic combination of amel & charcoal & diffusion.
Wide Stripe – Unproven pattern trait, creates an aztec pattern which often consists of connected saddles forming a wide wavy dorsal stripe.
Wild-type – *See Normal.*

Z

Z – *See Cinder.*
Zigzag – Variation/selective breeding for a pattern where the left/right halves of the saddles are offset, creating a zigzag.
Zipper – *See Zigzag.*

Index

About the author:

Although his extensive cornsnake collection is his main interest, Charles Pritzel has been keeping herps of one kind or another since the late 80's. His hobby started with a wild-caught snapping turtle, and later included various small lizard and snake species.

In addition to the annual Cornsnake Morph Guide, Charles also publishes Genetics For Herpers. Along with his wife Connie Hurley, he co-owns/operates the American Cornsnake Registry and The Cornsnake Source discussion forums. He has participated in various cooperative efforts by the cornsnake community to determine the inheritance patterns of several genes including ultra, dream, masque, and strawberry.

In addition to herps, his main interest is computer programming. He is currently a stay-at-home father, author/publisher, and part-time CTP operator at the newspaper. In addition to serving in the Air Force/Air National Guard, his past jobs have included quality control engineer, software engineer, video game designer, and electronics technician.

Comments, questions, corrections, submissions, suggestions, or complaints? Come talk with us on the web at: **http://cornguide.com**

Or email the author directly: **serp@cornguide.com**

As the mysteries of the cornsnake genome continue to unravel, another pattern gene emerges, and a striking new potential awaits testing. The 2009 Edition also includes several new genetic combinations, and a new method of morph identification.

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