

N-CSA Color & Pattern Terms and Definitions

This document provides definitions for each of the traits listed as selection options for “Color and Pattern” in the new N-CSA registration database. Traits are organized according to the genetic location (or *locus*) of the information within the sheep. Each locus has many genes called *alleles*. Each lamb has pairs of *alleles* (one from each parent) that determine its color and pattern, as well as all other aspects of its physical makeup.

Base Color: The Black/Brown Locus

Eumelanin pigments produce black or brown color in sheep at the *Black/Brown (B)* locus. The color black is dominant to brown. If both parents pass on an allele for black, the sheep will have black as its base color. If only one parent passes on an allele for black, the sheep will also have black as its base color. If both parents pass on the allele for brown, the sheep will have brown as its base color.

The *B* locus is symbolized by an uppercase “*B*” followed by the scientific shorthand for black (+) or brown (*b*). The “+” symbol is used for the most common variant of an allele. Every sheep will have two alleles at the *B* locus (for example, $B+B+$ = a black sheep).

Black ($B+$)—A black sheep may have some or all of the following attributes: black fibers in the fleece or hairy points, black coloring in the hooves, horns, nose, and soft tissues.

Brown (Bb)—A brown sheep may have some or all of the following attributes: brown fibers in the fleece or hairy points, brown coloring in the hooves, horns, nose, and soft tissues.

Pattern: The Agouti Locus

The *Agouti* locus is a modifier of the *B* locus. The *Agouti* locus is responsible for determining whether a mammal’s coat is banded with white/tan fibers in a bilateral pattern (*Agouti*) or is solid (*self-color*). Every sheep will have two alleles for pattern at the *Agouti* locus (one from each parent). Note any of the patterns, including *white/tan (Awt)*, can appear on a black or brown-based sheep.

Patterns with a large amount of white/tan tend to “dominate” the expression of darker patterns. *white/tan (Awt)* is the lightest pattern and is considered most dominant. *self-color (Aa)* is the darkest pattern and is considered most recessive.

Intermediate patterns are “co-dominant.” If a lamb receives two different pattern alleles the pattern with more white will probably be more visible, especially at birth. In some cases the two patterns will “co-express,” meaning both patterns are visible. Patterns listed below are in a hierarchy of “dominance” determined by the amount of white/tan in the display.

The *Agouti* locus is symbolized by an uppercase “*A*” with the pattern name’s scientific shorthand in lowercase letters.

white/tan (Awt)—This pattern may appear with random tan spotting, tan body, and/or tan face and legs. Tan is caused by *phaeomelanin* pigments which include shades of red, yellow, apricot, orange, ginger, brown, and gray. This coloring generally disappears by the first shearing. Kemp fibers when present are tan.

light badgerface (Albf)– White/tan body with dark belly. Similar to *badgerface (Ab)* with more white/tan frosting. Body/belly separation less defined. Look for frosting in the inner ear, throat, armpit, belly, scrotum, sides of tail/anus. Dark eye bar may extend from tear duct up to horn base. May have small white/tan moustache.

badgerface (Ab)–White/tan body with dark belly. Defined body/belly separation to tail tip. Dark eye bar with white/tan “shadow” above eye, dark patch under eye. Dark inner ear, dark muzzle, dark along jaw extending down throat to belly. Tan spots or patches may look like brown spots on the body. Tan spots are *phaeomelanin* and tend to fade or disappear by the first shearing.

gray (Ag)–Lambs born black or dark gray with wool changing rapidly to light gray or almost white by weaning (with dark tips). White/tan in front and rear flanks can be seen from the side, front flanks connected with white across or just above brisket. May have white ring around hooves. Frosted inner ear with dark rim. Frosted muzzle, chin, moustache and/or a white triangle from upper lip to nose bridge.

gray & tan (Agt)–Similar to *black & tan (At)* but the sheep is gray in areas where the *black & tan (At)* sheep is dark (black or brown).

blue (AbI)–Dark lamb with white/tan moustache or nose bar/ring extending up to tear ducts and forehead. White/tan teardrops low and off-the-duct. Dark nose. Rimmed ears. Frosted saddle area extending past shoulder and shy of tail head.

english blue (Aeb)–Very dark body. White display includes light saddle area, small at-the-duct teardrops, ear rimming, and small moustache sometimes extending up cheeks. May show a central ear spot.

black (or brown) & tan (At)–Opposite body/belly markings to *badgerface (Ab)*, dark body with white/tan belly. Defined body/belly separation to tail tip. Legs dark outside, white/tan inside. Frosted inner ear with dark rim, may have short white/tan eye bar, small moustache, light chin extending to bib. Also occurs in brown-based sheep, known as *brown & tan (also At)*.

swiss markings (Asm)– Dark lamb with white bars ascending from moustache past tear ducts to connect with ear. Ears rimmed white, inner ear frosted except tips. White neck kerchief ends behind ears. Dark body, frosting on belly. Possible light area at top of rear leg or hip.

lateral stripe (Als)–Very dark body/belly with defined white stripes along belly from elbow to knee, dividing body from belly. Fibers in the stripe are fully white from tip to base. White chin, or white moustache may sweep up dramatically. Tight at-the-duct teardrops. Dark ears with pronounced white inner ear rimming and some outer ear rimming.

self-color (Aa)–This is the most recessive pattern. It presents as a completely dark sheep, either black or brown. When two agouti-patterned parents produce solid color, it is definitely **Aa self-color**. When two solid color parents with unknown alleles produce solid color, it might be **Aa** if both parents are **EdE+** and both carry **Aa** or it might be **Ed** solid color depending on which extension alleles are inherited. White spotting may still occur.

Spotting: The S Locus

Spots are irregular areas of true white (not tan) appearing on a black or brown sheep. Unlike the white/tan banding of the *Agouti* locus, *Spotting* is random and asymmetrical. It often shows up first on the midline (head, tail, anus, bottom of the legs). Extensive spotting may partially or entirely obscure underlying *Agouti* patterns, especially as the sheep matures.

The *Spotting* locus is symbolized by an uppercase "S." "No spotting" (S+) is a dominant gene and "spotting" (Ss) is a recessive gene at the S locus.

Common examples of the effect of the S locus in our breed include:

Blaze—White extending up the bridge of the nose to the forehead.

Cap—White on top of the head.

Anklets—White ring encircling the ankle.

Socks—White from the hoof to above the ankle.

Tail tip—White on the tip of the tail.

Pinto—Looks like large patches of color on the body, may involve the head area.

Ticking—Looks like freckle-like patches of color on the body.

Random—Irregular areas of white appearing anywhere on the sheep. Can make pattern identification tricky without birth photos.

Spotting is indicated in the horn and hoof by the *absence* of dark color. Horns/hooves may be light-colored or striped. One can also look for the absence of color in the nose and lips which may appear pink instead of black or brown. This is common in the *white/tan* (*Awt*) pattern where the S locus may suppress all color including tan.

Dominant Color: The Extension Locus

There are two reasons why Navajo-Churro sheep can appear solid black or brown. One is due to the *self-color* (*Aa*) allele at the *Agouti* locus and the other is due to a dominant color gene from either parent at the *Extension* locus. Most sheep breeds (and many of our Navajo-Churro sheep) receive the "wild" gene from both parents at *Extension* (*E+E+*) which allows full expression of patterns at the *Agouti* locus. The *Extension dominant* (*Ed*) allele from one or both parents overrides patterns at the *Agouti* locus and results in a solid black or brown sheep. Note that white spotting (such as cap or socks) may still appear.

Due to their solid coloring an *Ed* sheep is easily confused with a *self-color* (*Aa*) sheep. A determination about *Ed* or *Aa* is made through progeny testing. Sheep receiving an *Ed* gene from each parent, (*EdEd*) will only produce solid offspring. Sheep receiving an *Ed* from one parent (*EdE+*) will statistically produce more solid offspring than an *Aa* sheep in any birthing. *Aa* sheep will most often produce offspring with patterns.

Other Possible Alleles

We are using this category in the database to gather information about important “types” within the Navajo-Churro breed. They are driven by unproven (but suspected) alleles or other modifiers we need to identify.

Blue Dilute—Also known as *NSP Blue*. Born black but in the first year develops silver/charcoal inner coat while outer coat remains brownish/black. May have cap, small blaze or other white spotting, but will keep dark points and legs. Resembles *Gray (Ag)* but does not have sugaring of lips or points. First year fleece has tips and fibers are gray to the roots (not a mix of black and white). The mature sheep retains a “blue gray” fleece on body/belly that may lighten with age. Often a bronze/metallic sheen to face, ears, and legs. No white tear drops.

Brown Dilute—Similar to *Blue Dilute* but on a brown-based sheep.

Dark Brown—Also called *Rio Grande* wool color. *Dark Brown* sheep are born nearly black and the wool remains a dark color between black and moorit brown. At a year fleece remains dark chocolate brown which may lighten with age. There may be minor spotting and perhaps reddish brown oxidizing of the tips (that also occurs in black sheep). The dark brown wool is more obvious when compared side-by-side to black wool.

Churra markings—A white sheep with clustered dark marks or large dark patches around the eyes and mouth/muzzle. May also have a dark inner ear. The visible dark (black or brown) is the base color of the sheep. “Churra marked” sheep will continue to be registered as *white/tan (Awt)* although it is unclear in the scientific community whether Churra markings are a “pattern” driven by the *Agouti* locus, spotting due to the *S* locus, or some other genetic mechanism.

Brockle-face/legs—Freckling or “dappling” of face and legs on a white sheep. The visible dark (black or brown) is the base color of the sheep. “Brockle-face” sheep will continue to be registered as *white/tan (Awt)*. As with Churra markings, it is unclear exactly which allele drives the appearance of “brockle-face.”

Important Pattern Markings

The markings listed below are components of *Agouti* patterns. Recording them in the database allows us to more accurately describe each sheep and assists with pattern identification. If you already know the pattern of your sheep (for example, *Badgerface* or *English Blue*), it is not necessary to select all of the pattern markings.

The table that follows offers a description of the markings and the associated patterns they usually appear with. Patterns can also appear incomplete because of random spotting.

Pattern Markings	Definition	Associated Patterns
Eye bar/swoosh	May appear light or dark. Short and close to the eyes, or extending from tear duct up to base of horn or ear joining. May connect to moustache in a U shape.	Light Badgerface, Badgerface, Black & Tan, Swiss Markings
Eye patch	May appear light or dark. Patches encircle the eyes. May extend down along the nose and into the cheek area.	Light Badgerface, Badgerface, Black & Tan
Eyeline	Dark lines surrounding the eyes.	White/Tan, Churra
Teardrops	White/tan areas that may be tight (at-the-duct) or low (off-the-duct). Sizes vary.	Blue, English Blue, Lateral Stripe
Rimmed outer/inner ears	Clearly defined white/tan line rimming the inner and/or outer ear.	Blue, English Blue, Black & Tan, Swiss Markings, Lateral Stripe
Frosted inner ears	White/tan fibers inside the ear.	Light Badger, Gray, Black & Tan, Swiss Markings
Nose bar/ring	White/tan bar over the bridge of the nose. May wrap around muzzle and/or extend up to the tear ducts and forehead.	Blue
Mouth/nose triangle	White/tan area around the muzzle extending up to a "point" on the bridge of the nose.	Gray
Moustache	White/tan area above the upper lip. May sweep up behind the nostrils.	Gray, Blue, English Blue, Black & Tan, Swiss Markings, Lateral Stripe
Frosted muzzle	White/tan "sugar" covers the lips and nose, encircles muzzle.	Gray, Black & Tan and Self-color (with age)
Drool marks	Looks like dark drip marks at the corner of the mouth.	Blue
Fangs	Looks like dark fangs under the bottom lip.	Light Badger, Badger, Black & Tan
Collar, Bib partial	White/tan ring under the neck, ends behind the ears but can extend from chin to throat	Swiss Markings Black & Tan
Collar, Full	White/tan ring that encircles the neck	Black & Tan
Bib, Full	White/tan wide band extends from chin to brisket	Black & Tan
Hoof ring	White/tan ring directly above the hoof.	Gray, Gray & Tan
Light body	White/tan fibers on upper side/body area. May be separated from dark under side by a defined line or look like frosting/dappling on the body of a dark sheep.	Light Badger, Badger, Blue, English Blue
Light belly	White/tan fibers on under side/belly area. May be separated from upper side by a defined line or look like frosting/dappling on the belly of a dark sheep.	Gray, Gray & Tan, Black & Tan, Swiss Markings
Light stripes	Defined white/tan lines along belly from elbow to knee. Fibers white/tan from skin to tip of fiber.	Lateral Stripe
Hipspot	Looks like a dark spot covering the hip/flank.	Hipspot Badger
Midsides	White/tan patch or frosting in the saddle area on a dark sheep. May appear rust-colored.	English Blue, Rusty Midsides

Birth/Adult Wool Color

Birth and adult wool colors are included for each animal in our database in addition to genetic color and pattern terms. *B* locus color (black or brown) and *Agouti* pattern remain the same for the life of the sheep whereas wool color may change from birth to adult. An older black sheep and a patterned *gray (Ag)* sheep might both produce *Silver* wool. An *Extension Dominant (Ed)* brown sheep might produce *Red Mesa* wool as a lamb and *Sand* years later. Please note terms below are specifically for wool.

White—No colored fibers.

White Shell—Mostly white with some tan fibers or off-whites.

Sand—Light beige, tan, light brown, fawn.

Adobe—Medium brown, caramel.

Jaspered Brown—Mostly brown with coarse white fibers.

Red Mesa—Reddish brown, coppery, red-moorit.

Mesa—Brown, moorit.

Rio Grande—Dark brown-black, deep chocolate.

Sombra—Light gray/tan. Mouse. Not really gray. Not brown.

Pearl—Mostly white with some black fibers or off-whites.

Silver—Light gray.

Slate—Light gray with steel, metallic blue overtones.

Storm—Dark gray.

Jaspered Black—Mostly black with coarse white fibers.

Jet—Black with no white and little or no browning.

Horn Color

Horn color will be captured in the database. This data point is indicative of whether or not an animal is recessive at the *S* locus (resulting in spotting in the sheep and potentially its offspring). It can also be indicative of the base color (black or brown) at the *B* locus.

Light—Light-colored or white.

Dark—Dark-colored. Black/gray or brown depending on the base color.

Striped—Light-colored with dark stripes.

Unusual Traits

These are uncommon but notable traits in Navajo-Churro sheep.

Mane—Whisker-like hair fibers from the chin down the chest. Not wool.

Topknot—Large puffy wool cap. May indicate multi-horn gene.

Wattles—Two fleshy lobes hanging from the chin or throat.

We welcome your feedback and questions regarding this document. If there are patterns or traits in your sheep that you don't see reflected in this work we would be thrilled to hear from you. Please feel free to contact Connie Taylor at churrosheep@me.com, Ingrid Painter at puddleduck@proaxis.com, Kelli Dunaj at kadunaj@yahoo.com or Kim Kerley at kim.kerley@earthlink.net with your feedback or comments.

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