

# EVALUATING GOTLAND COLOR AND PATTERNS

## WITH BASIC COLOR PRIMER

GSBANA Education Committee  
April 2023



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Photo from: Dr. Polly Matzinger, Amblingbrook Farm

# Gotland Breed Characteristics

**will be reviewed in detail  
in this presentation**

Please note that the Gotland Sheep Breeder's Association of North America standard is not the same as the Swedish standard. Sheep meeting the Swedish Standard will meet the GSBANA standard. Sheep meeting the GSBANA standard will not necessarily meet the Swedish Gotland standard.

- VISIBLE COLOR AND PATTERN (Phenotype) – solid color grey, black, or white fleeces; with shading allowed. Fawn and brown are also accepted in the GSBANA registry.
- Genetic (Genotype) patterns other than white, grey and/or self/solid are not allowed.
- Non-allowed genetic patterns include but are not limited to the following genetic patterns (these patterns are visible at birth): Blue including English Blue, Mouflon, Badgerface.
- Grey fleece color ranges from light silver to dark charcoal with head and legs generally solid black. Lamb birth coat is usually black, white or brown. Most of the black lambs become grey and brown lambs become fawn within a few months.
- Small white spots on head, legs and/or tail are accepted but discouraged; such spots shall be less than 30% of the areas on which they appear. (Light grey eye circles and muzzles are not white spots and are allowed.)



SOURCE: Gotlandsfåröreningen Facebook page

# Evaluating Color Quality:

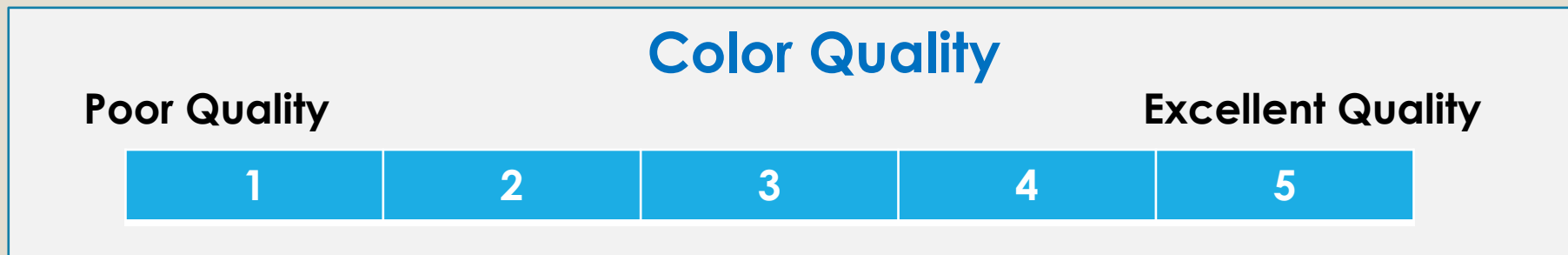
- Only Gotland lambs are even in their grey color. Older, mature sheep can develop a dorsal stripe and more dramatic color variations.
- Mark down for:
  - Salt & pepper
  - Patterns
  - White spots/patches on body
  - Color fade on tips of curls, face or leg, especially brown tips

# Quality includes Consistency:

- Consistency should be over the full body
- Overall color consistency at shoulder/mid-side/leg
- Evenly distributed
- Mark where the sheep shows color inconsistency: neck, mane, side, back, abdomen, breech/britch, tips etc.



SOURCE: Gotlandsfårsföreningen Facebook page  
"Congratulations Caroline and Johan Bröjer, Heby, whose ram 22005 Eric-Andersgården's Hamlet received the Gotland Sheep Association's prize for ram with best fur characteristics at the auction on Gotland"



# Basic Color Primer

This color primer covers a brief description of color genetics, relevant alleles at the B, A, E, and S loci, and the desired Gotland genotype.

There are many things we don't know about color genetics - yet! Most of those provide variations within the "main" colors and patterns.

When you understand basic sheep color concepts, you can also understand and start to predict genetic outcomes in your own flock so that you can make decisions that support the goals you have for your own herd.

# On Color...

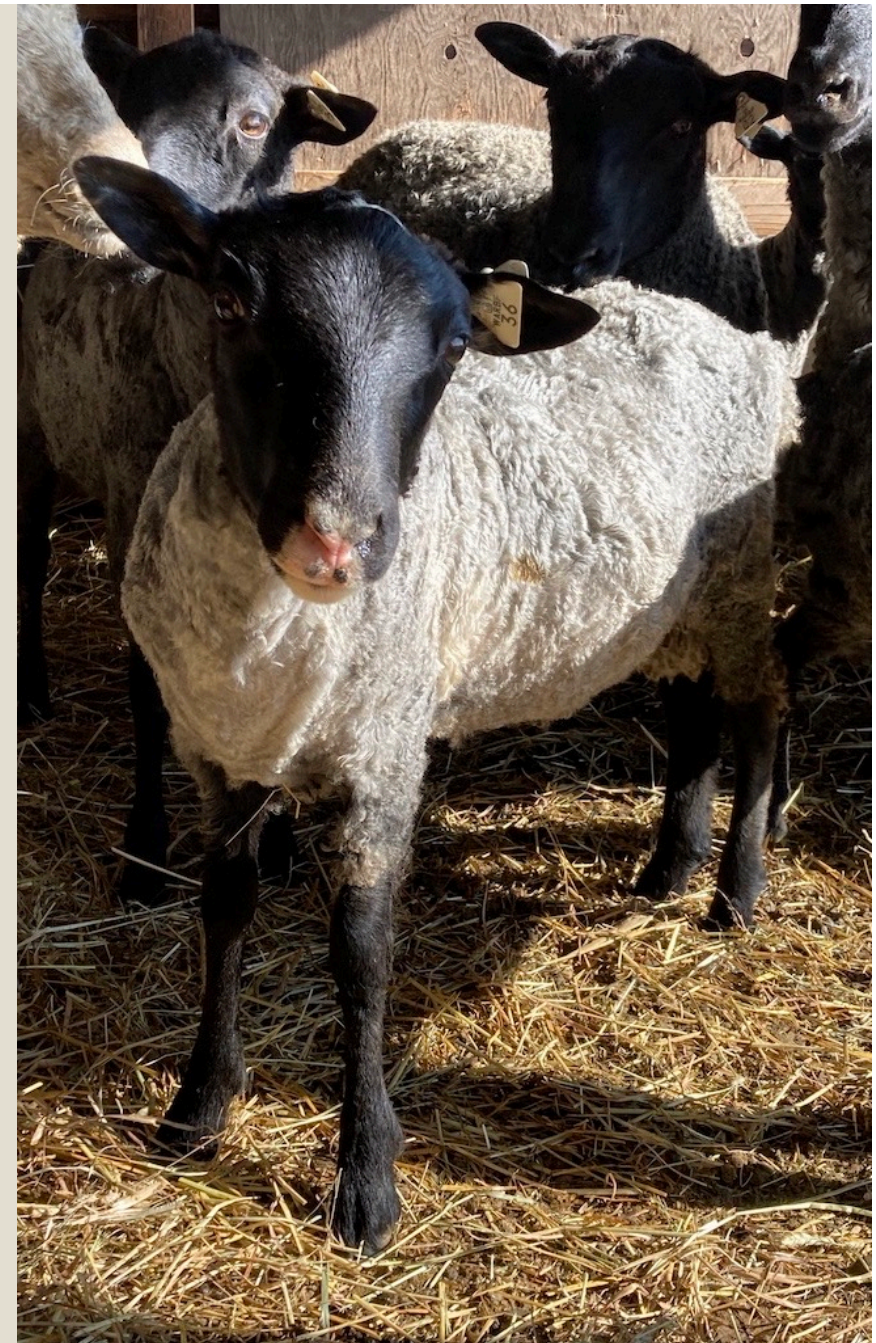
In determining the color of a lamb, it is important to look at both wool and skin pigmentation.

You should be able to determine whether the lamb's base color is black or brown from face and leg hair color.

If any lighter hair or wool is growing from pink skin, spotting is present. If the lighter hair or wool is growing from pigmented skin, patterning is present.

Symmetrical markings are important to notice.

We will discuss a variety of changes in color related to age and other factors in this primer. All color, patterns and spotting are visible at birth, but what they look like will change with age, so it is best to document color and any markings at birth and regularly as the lamb ages.



# Foundation breeds and color

- The classic grey Gotland sheep breed, developed in Sweden over 100 years ago from the Gute sheep, has a small number of color alleles in their Gotland gene pool.
- Ten breeds are allowed as Foundation Ewes in the GSBANA Flock Book. These ten breeds bring a myriad of colors and patterns into the gene pool. The foundation sheep breeds approved by GSBANA have either a body type or fleece type like Gotland sheep.

## **FOUNDATION BREEDS:**

### **Northern Short-Tailed Breeds**

Shetland Sheep (S)  
Icelandic Sheep (I)  
Finnsheep (N)

### **Longwool Breeds**

Wensleydale (W)  
Lincoln (L)  
Cotswold (C)  
English Leicester (E)  
Border Leicester (B)  
Bluefaced Leicester (F)  
Teeswater (T)





Gutefår (Gute ram)



Gotland ram

## From Gute to Gotland

Clearly our beloved Gotland breed has been refined over the years through rigorous selection.

Many of the characteristics we select against come from the foundation breeds.

# Basic Sheep Genetics

Each sheep carries one “card” from each of its parents for each element of:

- 1) **Basic Color**,
- 2) **Pattern**, and
- 3) **Spotting**.

The lamb’s genetic profile – what we can see (phenotype), and what they can pass to their offspring (genotype) - is the “hand” they are dealt from their sire and dam.

“**Coloured Sheep – a primer in sheep colour genetics**”

(English spelling of colour)

by Irina Bohme, and Saskia Dittgen

**The SIRE**  
contributes a  
card for each of  
the following  
3 areas:

**The DAM**  
contributes a  
card for each of  
the following  
3 areas:

## 1) **Basic Color:**

(B Locus)

Black (Bb) or Brown (BB)

## 2) **Pattern:**

(A Locus)

Grey, Solid,  
White/Tan, Blue,  
Badgerface/Mouflon,  
(or combination of the above)

## 3) **Spotting:**

(S Locus)

Spots or no spots



# Phenotype – what we can observe

The phenotype is the characteristics of an individual that we can observe and measure such as weight, coat color, size, exterior, milk yield.

The phenotype of an animal is always a mix of its genetic background and the environment. Environmental factors are important to consider and deduct when trying to estimate an individual's genetic value since only the genetic factors can be passed on to the next generation.

Phenotype is measured by visual, tactile, technical measurements and comparisons, estimating the expression of genes in a living animal or carcass. The accuracy of the measurements can be enhanced by using objective tools like analysis for wool diameter, scales for weight, etc.

# Assess VISUAL (Phenotype) color at around 3.5 months



(Ljusgrå)

**Light Grey**



(Mellangrå)

**Medium Grey**



(Mörkgrå)

**Dark Grey**

These are all grey for the purposes of registration



(Vit)

**White**



(Svart)

**Black**



(Moorit)

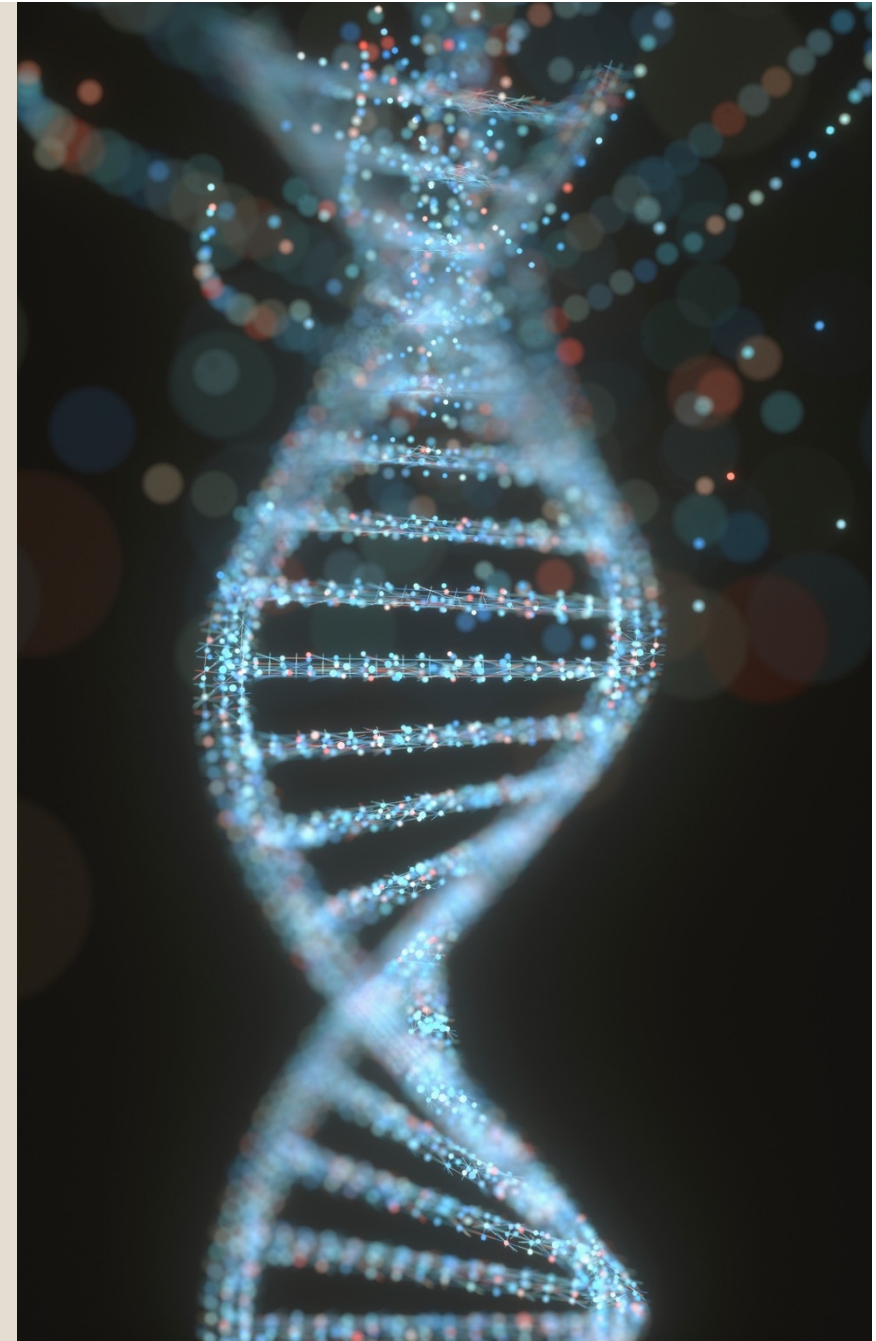
**Fawn or Brown**

# Genotype – what genes are present

The genotype of an individual is the set of genes present in the chromosomes and each generation will inherit 50% of the genes from each parent.

By using phenotypic scoring, genotypic indexes and/or genomic tools, we can describe how well an individual aligns with a range of various traits important for the breed.

The breed standard helps us maintain the phenotype of our animals and the population as a whole over time. It will also help us decide on which animals to keep or cull on the flock level.



# 1 Basic Color

## B LOCUS

- **B - KNOWN AS THE BLACK/BROWN LOCUS**  
There are only two alleles associated with B - black and brown. B determines which type of eumelanin is expressed in the sheep, black or brown. All sheep are either black or brown at this locus no matter what the phenotype of the sheep is.
- BB - black, dominant to brown. Gotland sheep with 100% Swedish genetics are presumed to be homozygous BB.
- Bb - brown, recessive to black, must be homozygous to be seen in the phenotype. Common in Icelandic and Shetland sheep. Present but not common in Finnsheep. Probably uncommon in the Longwool breeds.

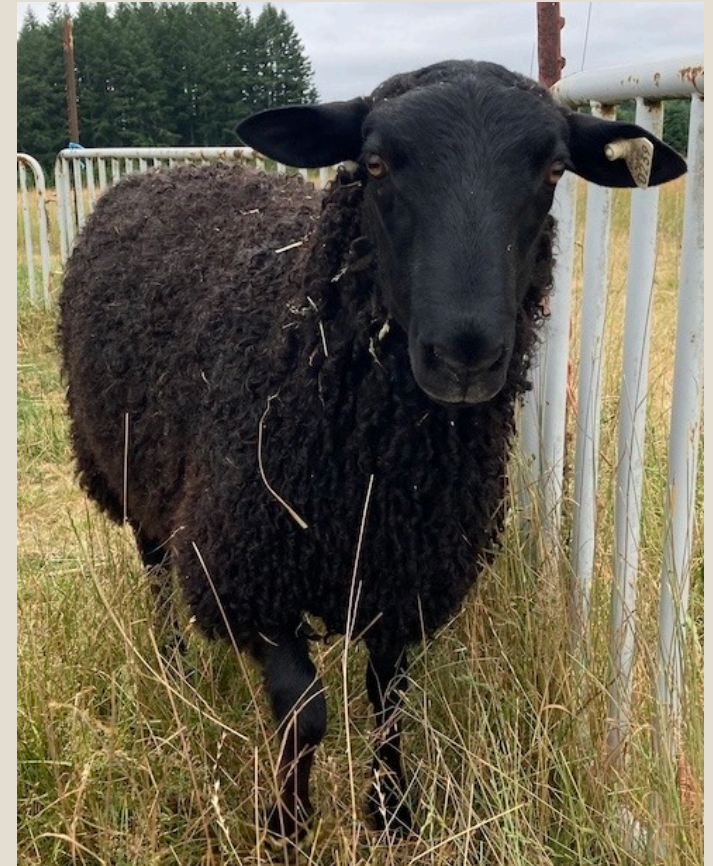
BB

Black is  
**dominant**  
to brown

Gotland sheep with  
100% Swedish  
genetics are  
presumed to be  
homozygous BB



Notice the black pigment  
in the circled areas

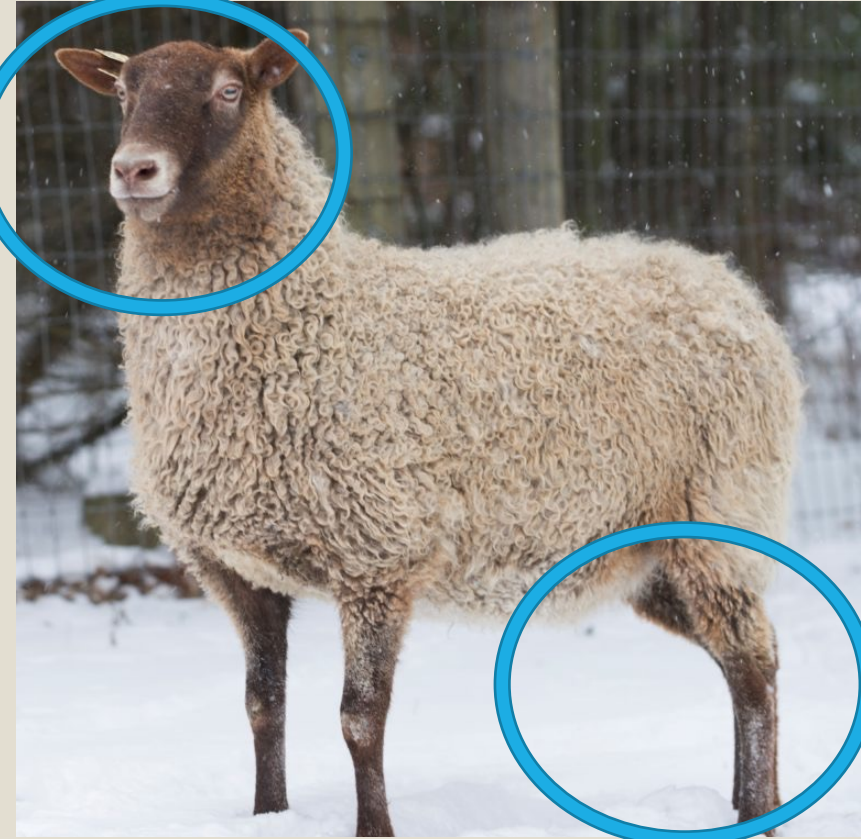


Bb

Brown is  
**recessive**  
to black



Notice the brown pigment in the circled areas



Some American breeders are selecting for brown (also called moorit) color. Gotland Sheep Breeders Association of North America (GSBANA) is the only association that allows registration of moorit (brown) Gotland sheep.



# 2 Pattern A LOCUS

A - KNOWN AS THE "PATTERN" LOCUS, it has many alleles associated with it. Many sheep color geneticists believe there are more yet unidentified patterns and variations to come. The A alleles control the extent and location of the two pigments, black/brown eumelanin and tan phaeomelanin.

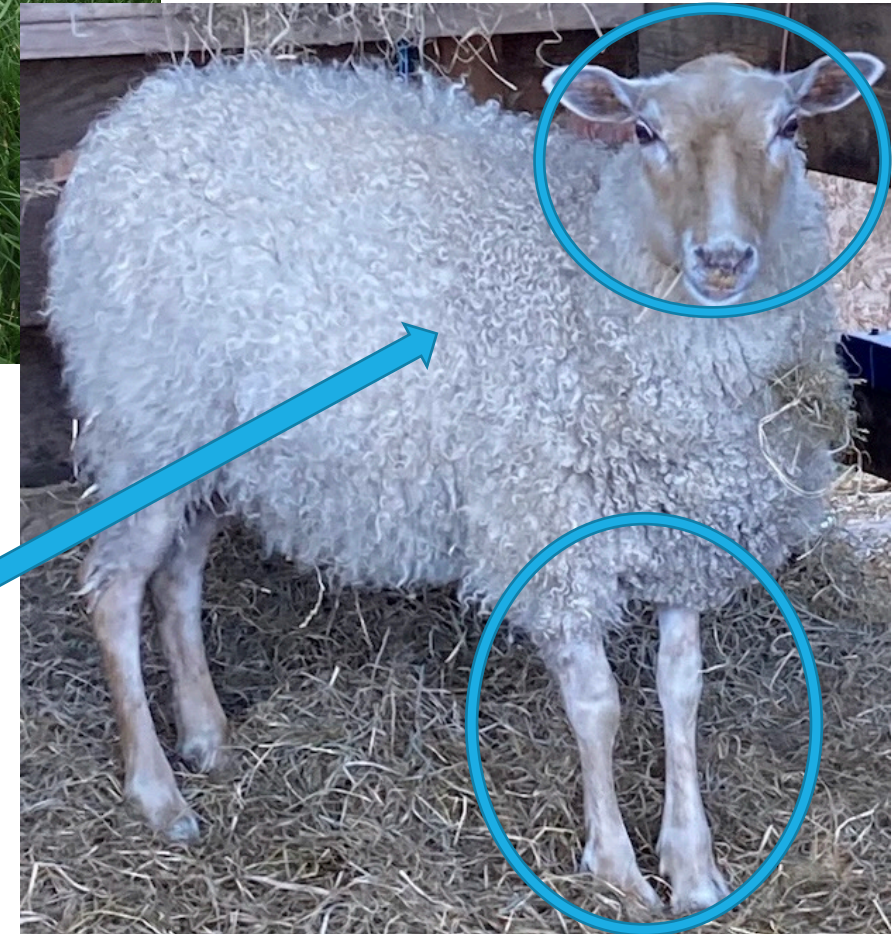
AWt

# White/Tan



These 2 pictures are of the same 90.82% Gotland lamb with AWt white/tan pattern. He is a few days old in the picture to the left, and about a year old in the below picture. Notice the tan shade on his nose and legs.

Notice the golden or tan color in his face and legs as a yearling. You can see that this color has faded.



Abl

AEb



<http://www.patchworksheep.co.uk/gotland-sheep/>

## Got the Blues? “English Blue”

Significant white in the ears and bilateral white (i.e. on the flanks) can be a sign of a Blue (Abl) pattern.

The teardrop markings, however slight, are a telltale sign of the English Blue (AEb) pattern.

Ab

# Patterns: “Badgerface”

“Light fleece  
dark belly”  
at birth

Top: British  
badger  
Bottom: light  
badgerface  
ewe lamb



At



Here you see 2 adorable Icelandic lambs displaying the 2 different patterns for badgerface and reverse badgerface (also called mouflon):

- **BADGERFACE:** Light fleece with dark on chest and underbelly (in back)
- **MOUFLON:** Dark fleece with white on chest and underbelly (in front)

Patterns:  
“Mouflon”

(AKA reverse  
Badgerface)

“Dark fleece  
light belly”  
at birth

Aa

90 days old



6 months old



18 months old



Swedish AI son out of UK ewe

“Patterns”

Solid

The lamb usually keeps the solid body color through its first year.

This 87.5% ram is showing fading over his shoulders with some sun bleach and probable grow-out after experiencing mineral deficiency.

Ag



## “Patterns”

### Grey

Phenotype is expressed as a solid color in lambs with telltale white wisps in the ears, the groin, and sometimes in a necklace, along with "sugar lips".

Agg

Ewes and ewe lambs from Open Reach Farm, MT. Notice the older ewe in the middle with a darker dorsal stripe commonly seen in mature Gotlands.



SOURCE: Ib Hangaard Hansen at Lykkegaarden, Denmark

“Patterns”

Gotland Grey

The existence of this allele is unproven, however, there is evidence that Gotland grey is distinct from Ag, and that other color and wool characteristics are inherited along with the Gotland Grey. The phenotype is very similar to Ag, with a very distinct change to grey at 1 to 2 months of age.



# Wait...

## Grey is a pattern??

Yes, technically speaking, Grey/Gotland Grey IS a pattern. Some sheep show light eye circles and noses - also typical of Ag - or the well-known grey seen in other Northern Shorttail sheep breeds.

The light nose and eye circles are pheomelanin and are not what we meant when we specified "distinct pattern". These can be almost white to almost gold. We included those in "shading that is allowed".

The lighter grey in those areas is not the same as the pheomelanin markings seen in the distinct patterns of Badger face or Mouflon or Blue.

We didn't specify Ag, Agg, or Aa because, if you look at Maggie Howard's book, there are a myriad of alleles at the A locus, many of which are still being discovered, and we wanted to be more general and include all "distinct patterns".

**Our nirvana is to have 2 Agg alleles at the A locus**

# Allowable shading on face

Light grey eye circles and muzzles or "sugar lips" are not white spots and ARE allowed.





## How do I know if my sheep is Ag or Agg?

The biggest difference between Agg and Ag appears to be the darker grey fleece. Most Ag/Ag sheep have very light fleece, almost white. Agg/Agg and Agg/Aa can be very dark. We generally assume that 100% Swedish Gotland sheep are Agg/Agg but Aa (Solid) is apparently in the gene pool as is Awt (White/Tan).

# Common color shifts in mature sheep

These common color shifts in mature sheep are the reason we evaluate Gotland lambs around 3.5 months. Only Gotland lambs are even in their grey color. As a result, adults should not be eliminated from a breeding program for displaying variations such as:

- Darker cape
- Darker dorsal stripe (down the spine)
- Age-related color shifts
- Seasonal color shifts
- Mineral related shifts
- Health related shifts
- Sun-bleaching



# Genotype of Gotland Colors



(Ljusgrå)

**Light Grey**



(Mellangrå)

**Medium Grey**



(Mörkgrå)

**Dark Grey**

Grey genotype:  $BB/BB$  Agg/Aa -OR-  $BB/BB$  Agg/Agg -OR-  $BB/Bb$  Agg/Aa -OR-  $BB/Bb$  Agg/Agg

White  
genotype:  
AWt



(Vit)

**White**

Black  
genotype:  
 $BB/BB$  Aa/Aa  
or  
 $BB/Bb$  Aa/Aa



(Svart)

**Black**

Fawn  
genotype:  
 $Bb/Bb$  Agg/Aa  
or  
 $Bb/Bb$  Agg/Agg



(Moorit)

**Fawn or Brown**

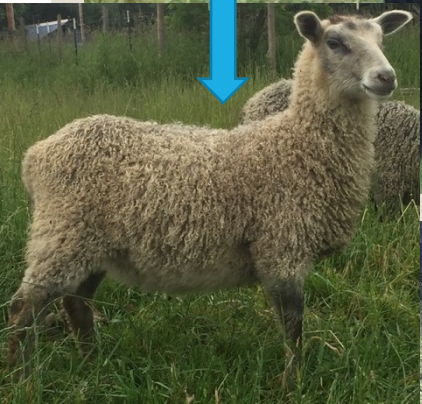
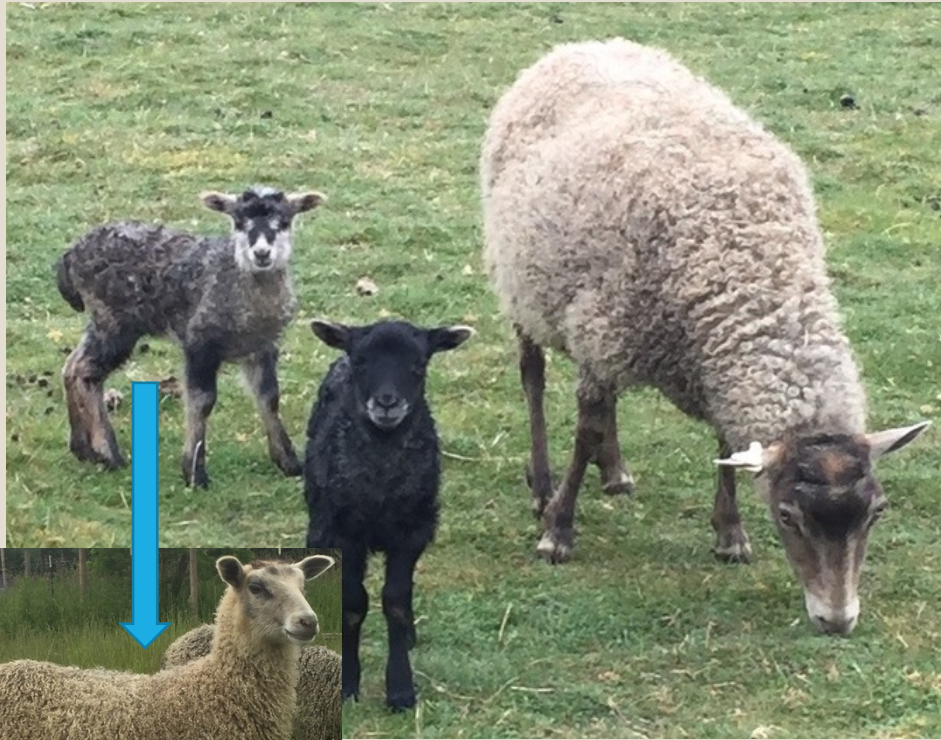
Brown  
genotype:  
 $Bb/Bb$  Aa/Aa

# E LOCUS

**E** - Known as the Extension locus, it has two alleles of importance to the Gotland upbreeding program. E controls the action of the A (pattern) locus and presence or absence of the two pigments, eumelanin or phaeomelanin.

**E+** - The "wild" allele. This allele allows expression of both pigments and turns the pattern locus "on", allowing expression of all the A locus variations. Present in all the Foundation breeds. Gotland sheep are presumed to be homozygous for E+.

**ED** - Known as Extension dominant. This allele hides the effects of the A (pattern) locus and inhibits phaeomelanin. White spotting is not affected. Common in the longwool breeds, ED is also present in North American Finnsheep and Shetland populations.



Color and  
pattern  
combos

# 3 Spotting

## S LOCUS

Spots show on several of the UK and Swedish import rams.

**S** - the spotting locus. Two alleles are important. S controls the presence or absence of white spots. It is postulated that other, as yet unidentified, loci determine the location and extent of the white spotting. It is also possible that multiple alleles exist at S, and that those unidentified alleles control the extent and location of the spotting.

**SS** - Dominant. Phenotype is the **absence** of white spots.

**Ss** - Recessive. Phenotype is the **presence** of white spots. There is some question as to whether small white spots indicate the homozygous Ss/Ss, or heterozygous. Ss spots are always white = lack of pigment, not white-tan phaeomelanin.

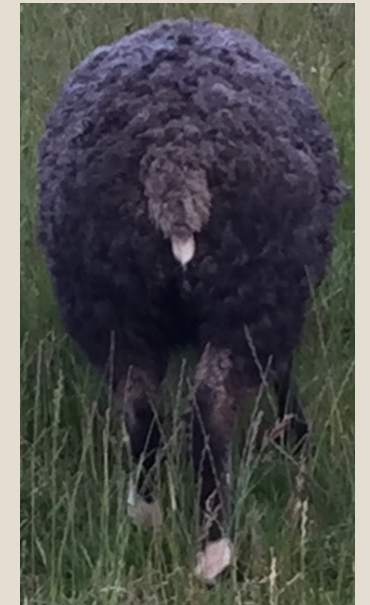
**Ss/Ss** state. Common in Finnsheep, present in Icelandic and Shetland sheep. Also present in UK Gotland lines. Seems to be uncommon in the Longwool breeds.





# Small White Spots

- Small white spots on head, legs and/or tail are accepted but discouraged.
- Spots shall be less than 30% of the areas on which they appear.





Lindholmen



Ervalla Ztrong



Sindarve Amor



Ervalla Grey Fifty

Swedish  
rams with  
spots



Zorro



Fabian



Rolls Royce

UK rams  
with spots

# Spots in Body Wool

White spots in the body wool are not desired. The dark spots you see below are likely a one-off mutation during mitosis where the "normal" genotype doesn't represent that local phenotype.



The lighter silver patch above is also likely to be a one-off mutation. This ewe has only had solid black lambs with 3 different sires.

# What about these “spots”?

After shearing, it is common to see different spotting or patches of colors through the body wool of a mature Gotland sheep. Some may describe these as Dalmatian type markings.

This will look like obvious salt and pepper in the fleece and is not desirable.



# Salt and Pepper

- Visible black and white fiber groups, not necessarily big patches, but noticeable without a hand lens vs. a homogenous mixture of black and white fibers.
- This characteristic gives the appearance of grey but is a mix of light and dark fibers.
- A true consistent color is desirable over visible salt and pepper in the fleece.
- With that, hand spinners love fleeces with this variation, and dyed fiber using salt and pepper fleeces is unique and beautiful.



# Spot Disqualifications

- White spots in the wool adjacent to the head, legs and/or tail are disqualifying in rams and discouraged in ewes.
- Spots greater than 30% of the areas on which they appear are a disqualification, and the sheep should be recorded rather than registered.
- In ewes only, white spots in the wool that are adjoining allowed white spots in the haired areas (<30% of the haired area) and are smaller in area than the adjoining haired white spot, are discouraged, yet allowed.
- In ewes, these spots shall be smaller in area than the adjacent portion in the non-wooled area.
- Otherwise worthy sheep who do not meet the GSBANA standard may be Recorded with the Association and used in breeding programs.





Gotland  
Color  
Deviations

Inconsistent  
Body  
Color



# Inconsistent staple color



**Normal Diet**



**High Sulphur Diet**

- Part the fleece and observe the color of the staple length from body to tip
- Color bands or shifts in color are not desirable, but not necessarily genetic.
- Shifts in color can be caused by seasonal, stress or dietary changes
- Color bands in wool can be caused by mineral imbalances.
- In this picture, we can see that a high sulphur diet has caused an acute copper deficiency, resulting in the new lighter wool growth in the bottom image.



Red tips



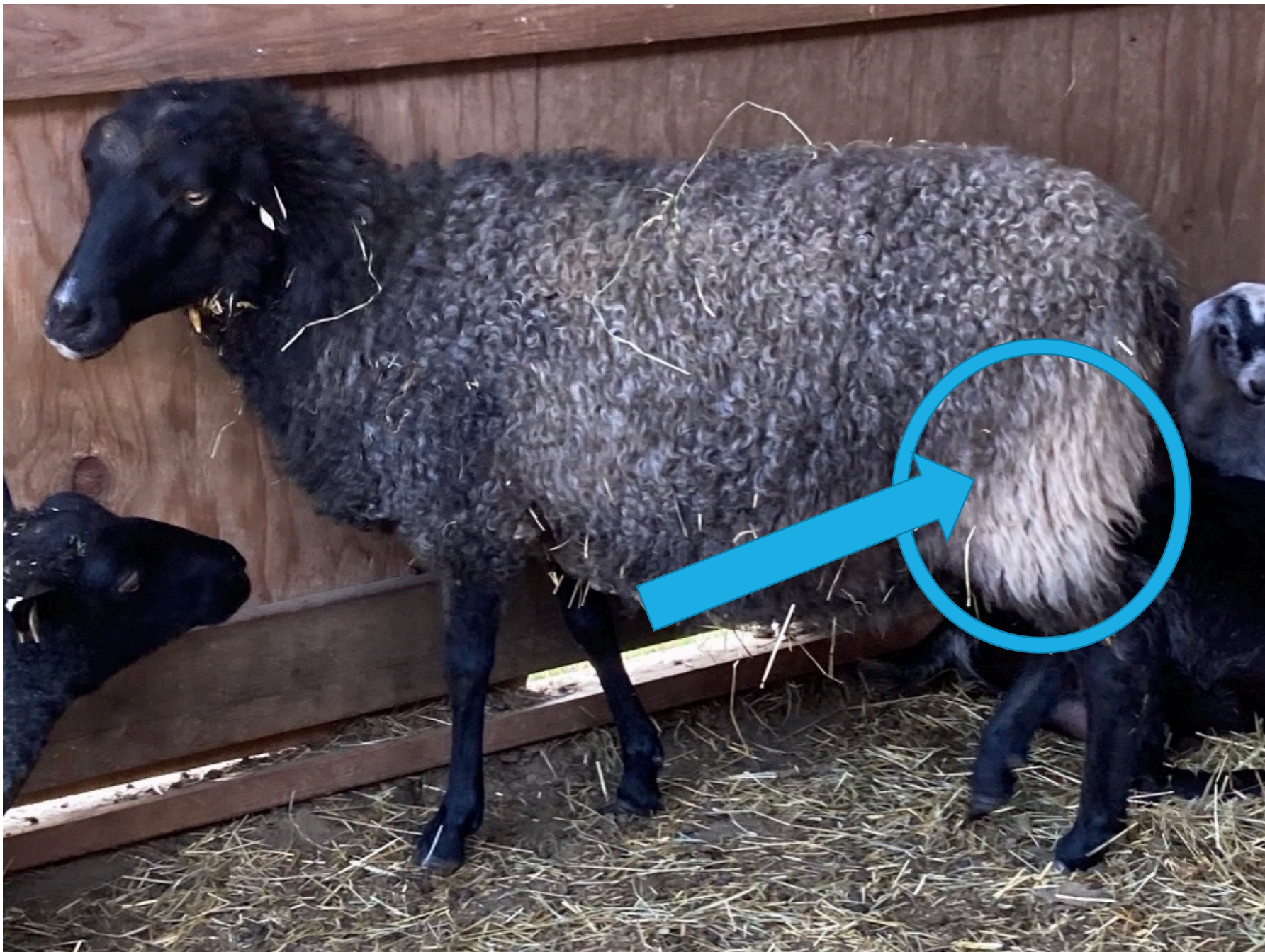
# Red or blush tips

- Part the fleece and observe the color of the staple length from body to tip
- Red or blush tips are not desirable



# Faded or sun-bleached tips

- Part the fleece and observe the color of the staple length from body to tip
- Faded tips can show on adult fleeces, but are not desirable in a lamb's fleece at evaluation



## Gotland Color Deviations

### Color Fade and texture on britch

Faded britch can be more visible in adult fleeces, but are not desirable in a lamb's fleece at evaluation



# Gotland Color Deviations

Color Fade on  
face or legs

This deviation is not as  
important if fleece  
color is uniform

- Medium Gotland grey
- Uniform color throughout the body wool
- Uniform color from body or cut end to tip
- Solid black head and legs
  - “Sugar lips” and light shading around eyes and nose is common and acceptable

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## Desirable Characteristics

# Mark down for Deviation from ideal

---

Inconsistent body color

---

Inconsistent staple color

---

Red or blush/sun-bleached tips

---

Color fade on britch

---

Color fade on legs, face

---

Patterns

---

Spots in body wool

# What if my sheep has a deviation(s)?

Sheep submitted for GSBANA Registered status shall meet the breed standard set forth by GSBANA.

Otherwise worthy sheep who do not meet the GSBANA standard may be Recorded with the Association and used in breeding programs.

This would include sheep with patterned fleece or excessive white spots.

For more information about deviations in color, we encourage you to join the Facebook page dedicated to studying patterns in Gotland Sheep.



# Gotland Sheep Pattern Study

There is a Facebook page dedicated to studying patterns in Gotland sheep.

It's important to notice color differences in your lambs as early as the day they are born (after they have dried off). If you have anomalies in color with anything other than solid black, and you'd like to participate in a Gotland breed Pattern study, it's a good practice to take pictures at multiple angles for reference, and at different ages: 1 day to 3 weeks, at evaluation (+/- 3.5 months), 6 months, 2 years - unsheared and sheared if available (and parted fleece shots) to include pictures such as:

- Straight on head including ears
- Lift head to show chest and neck up to the jaw
- Both sides (if different) straight on including head
- Ears front and back if not clear in other photos
- Complete underside
- Top down showing entire back

Other information – tag #, age at photo, % Gotland and pedigree showing breed/patterns of animals in it.

**Make sure you take photos in good light and ensure that any color anomalies are clear in the above photos. Post to Facebook group: [Gotland Sheep Pattern Study](#)**

- Margaret Howard's recorded talk about color at Black Sheep Gathering
- <https://www.livingwithgotlands.com/2017/04/three-distinct-phases-of-a-gotland-fleece/>
- Evaluating Gotland Curls  
(will link when available)
- Evaluating Gotland Lambs  
(will link when available)
- Marketing Wool  
(will link when available)
- And much more!

**Don't miss all the latest in the  
Members Learning Library on GSBANA.org!  
Please contribute your perspective on these  
topics in the GSBANA Business Group!**

# Additional Content

Related to  
Evaluating  
Gotland  
Color

Kirsten Simons, CPTD (Chair)

Nansi Castillo, GSBANA President

Dr. Polly Matzinger, Ph.D.

Dr. Paula Byrne RN, DNP

Lacy Dalton

## **GSBANA Education Committee Members**

We welcome other members to contribute to education for GSBANA members!  
Together we are better!

# APPENDIX: Related Term Definitions

- Gene - Single trait controlled at one location (locus) in the DNA strands - i.e., eye color
- Allele - One of several options available for each gene - i.e., blue eyes, brown eyes, green eyes
- Gene Pair - Genes always come in pairs, no more, no less. One from the sire, one from the dam.
- Homozygous - Gene pair with two identical alleles
- Heterozygous - Gene pair with two different alleles
- Genotype - The actual alleles present at each gene locus
- Phenotype - The appearance of the sheep, may or may not represent the complete genotype
- Dominant - An allele that appears preferentially in the phenotype and hides the effect of other alleles
- Recessive - An allele that doesn't express itself unless it has two copies at the locus (homozygous)
- Co-dominant - The effects of both alleles can be seen in the phenotype
- Eumelanin - Type of pigment responsible for the black and brown coloration of sheep. Eumelanin can be found in both hair and wool fibers.
- Pheomelanin - Type of pigment responsible for white/tan coloration in sheep. Pheomelanin is usually found in the hair fibers of the face and legs and in the birth coat.

# References and Resources

- Gotland Sheep Compendium - Dr. Anette Skoog
- Gotland Sheep Color Discussion series - Franna Pitt
- Sheep Color Class - Dr. Polly Matzinger
- “**Coat of Many Colors**” book - Margaret Howard
- Finnsheep Breeders Association “Colors and Markings of North American Finnsheep”
  - [https://finnsheep.org/wp-content/uploads/2022/08/colorandmarkingsguide\\_82622.pdf?fbclid=IwAR3qFw65S8Yubs0aOB0boXKFFcm\\_3NHIJB-81j9okiylgJRpwp1YYeBi\\_sc](https://finnsheep.org/wp-content/uploads/2022/08/colorandmarkingsguide_82622.pdf?fbclid=IwAR3qFw65S8Yubs0aOB0boXKFFcm_3NHIJB-81j9okiylgJRpwp1YYeBi_sc)
- “Coloured Sheep – a primer in sheep colour genetics” (English spelling of colour) by Irina Bohme, and Saskia Dittgen
  - <https://independentstitch.com/2019/05/coloured-sheep-a-colour-genetics-primer.html>

Unless otherwise noted, most pictures came from Kirsten Simons at River Birch Farms and any color anomalies are usually (but not always) in lower % Gotland sheep. Hand spinners do love variety!