

# HOMOZYGOUS APPALOOSA COAT PATTERNS

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***"Few spot and snowcap coat patterns. Stallions studied each produced anywhere from 35 to 160 registered foals, involving from at least 11 to 84 QH/JC/CN/PC/ID mares per stallion."***

This report explores only a portion of the complex topic of Appaloosa color genetics and coat pattern inheritance. Our approach is practical rather than theoretical. We call it applied color genetics, the study of the relationship between an Appaloosa stallion's or mare's coat pattern (phenotype) and color production, or the extent to which a given coat pattern structure or type predicts the likelihood of an expressed coat pattern (color) in any resulting foals.

Group A of homozygous appaloosa coat pattern. What, if any, is the correlation between the type of coat pattern an Appaloosa expresses and the probability of producing color or characteristics in any offspring? Stated differently, is an Appaloosa's visible coat pattern indicative of its genetic color-producing potential or genotype?

While many of the genetic rules governing inheritance of Appaloosa color may remain hidden forever or continue to be the subject of mere speculation by color geneticists, we believe we have found substantial real-world evidence for several of these rules. Our report is not speculative, but based on data that seems to be overwhelming.

This article continues a research effort started years ago by Gene Carr and published in the Appaloosa News' November/December 1972 issue entitled, "Few-Spotted Leopards". His purpose then, as is ours now, was described in the article's opening paragraph: "Economics has prompted Appaloosa breeders to investigate systems of increasing the percentage of color in their foal crops."

While we hope to advance the scientific understanding of Appaloosa color genetics and coat pattern inheritance, our basic intent is more practical -- helping Appaloosa breeders understand how to produce a foal with color, or at a minimum, characteristics. Furthermore, we hope to impact on the market value of Appaloosas. If someone owns a "good" Appaloosa, and that stallion or mare can be predicted to produce an astonishingly

Group A



high rate of colored foals, we believe the value of such an Appaloosa will increase dramatically.

## Group B



Group B of homozygous appaloosa coat pattern. To date, this research has identified two homozygous Appaloosa coat patterns, the few spot and the snowcap. (See accompanying photos: Group A represents the classic few spot; group B classic snowcaps. "Classic" means the most recognizable pattern, allowing for some variations that'll be covered in further research reports.)

These patterns are homozygous, meaning such a horse carries identical genes for either of two traits: color--contrasting coat pattern, or characteristics, and often both. When a pair of genes is different, one dominant and the other recessive, the horse is heterozygous for that particular trait (color). Sometimes they will produce colored offspring, sometimes they will not. When a pair of genes is identical, that trait will be produced nearly 100 percent of the time. But how can this be determined at an applied versus theoretical level?

Carr was the first person to identify a few spot pattern and in fact, coined the term "few spot leopard". The "leopard" derives from lineage or parentage. The few spot is produced only from an Appaloosa to Appaloosa breeding where as at least one parent is a leopard. Such findings were based on observations of his own horses and the findings of several other breeders. Later research brought the snowcaps into the probable homozygous category but lacked the abundance of supporting data we are now able to present.

Without the development of genetic markers for homozygosity and actual DNA testing, how do we know these patterns are homozygous? A short explanation of the research methodology I used will explain the basis for our claim. (Note: to our knowledge, no Appaloosa stallion or mare has ever been tested scientifically to support a claim of homozygosity.)

1) Actual pictures of Appaloosas were used to identify the few spot and snowcap pattern. Picture quality was an obvious potential problem. In many cases, multiple pictures from different angles were required to determine whether or not a horse fit either of the patterns. While some pictures we solicited and received from stallions owners, most were published in Appaloosa News/Journal between 1961 and January 1998.

2) Stallion/mare production records were received from the ApHC and correlated with pictures. If a few spot or snowcap was identified correctly, the production record should reflect nearly 100 percent of the foals registered with some type of coat pattern or characteristics.



## Findings

This research has studied the individual pictures and production records of nearly 2,000 Appaloosas and Quarter Horse stallions and mares. From that sample, well over 200 Appaloosas, past and present, were identified as few spots or snowcaps, documented by their actual production records. Many more probably exist but could not be confirmed because of poor quality pictures.

### **Analysis of pictures, pedigrees, and production records warrants the following observations:**

Both few spots and snowcaps are produced only from Appaloosa-to-Appaloosa matings. Cross-breeding may produce what resembles a snowcap but is what we have termed a "false snowcap". Closer examinations of pictures reveals pattern differences, which when matched with production records, evidence the absence of an actual snowcap pattern. By definition, as any equine geneticist will confirm, and by what we have found, the product of a cross-breeding cannot be homozygous for Appaloosa color or characteristics.

Having 100 percent color/characteristics production does not mean a horse is homozygous. Only by genetic testing or breeding a minimum of 10-15 non-characteristic or out-crossed mares can a stallion's potential homozygosity be determined. Since a regular registered Appaloosa mare can contribute to color production, a stallion's production potential can't be tested adequately unless foals have been produced from non-characteristic (N/C) or out-crossed mares. (Note: mare owners should be extremely cautious of 100 percent color claims advertised in Appaloosa Journal. This research has found cases in which 100 percent color was true for a first foal crop of usually two or three foals. Such claims are accurate but misleading because they imply a color-producing potential that can't be justified, especially when pictures and pedigrees of the respective stallions are analyzed. More mares must be bred, especially out-crossed or N/C mares, before a 100 percent color claim can begin to predict colored foals from future breedings.)

Considering the Appaloosa-to-Appaloosa parentage requirement, only three cases were found in which an N or CN stallion or mare, properly registered, produced a legitimate few spot or snowcap.

While further pedigree research is being conducted at this writing, producing a few spot appears to require at least one leopard parent in either the first or second generation. For most of the few spots identified to date, the leopard was the actual sire or dam. Snowcaps are different and clearly do not require leopard parents, even though many have at least one. Many different types of coat patterns produced the snowcaps involved in this study. (Note: further reports will focus on the leopard as a complex of different patterns rather than one distinct pattern.)

The snowcap pattern appears to be far more common than the few spot. We do not know why. Perhaps fewer pictures of the few spots are published. Perhaps many few spot colts are gelded either because of the mistaken belief that the colt carries the graying gene, or, due to its lack of a distinct color pattern, cannot produce one. On the contrary many of the few spots examined in this research produced what by any definition is very loud color and then, often on CN, JC, or QH mares.

Both snowcaps and few spots are capable of producing an extremely wide range of coat patterns types or colors. Obviously, these variations are affected by a host of color modifying genes contributed by both a foal's parents.

Certain bloodlines appear to produce both few spots and snow caps mor frequently than others. With few spots, the leopard lineage makes the higher frequency understandable. Snowcaps are a different and more complicated story still being researched.

Homozygosity does not require 100 percent color or characteristics at birth. Anywhere from 5-10 percent of foals may be born non-characteristic or with characteristics only, but will develop Appaloosa characteristics at a later age. However, many of the horses in this study did have 100 percent color or characteristics production at the time of registration.

Nearly all of the few spot and snowcap stallions identified in this research actually produced 90-100 percent color/characteristics at the time of registration, including many foals produced from crosses to QH/JC/N/CN mares. (Stallions producing fewer than 20 foals were studied, but have not been included as part of this research report; mare production is a more difficult issue to resolve because many mares produce only three to six foals and then often from Appaloosa stallions; we can not defend a numerical production requirement for mares.)

Snowcaps are likely to roan out later in life although the age-specific start of the roaning process has not been determined. We have viewed pictures of Appaloosas that may be snowcaps, but lacking earlier pictures, are not able to make any determination. We suspect the existence of even more snowcaps than we have found to date.

## **Additional Observations**

We suspect that certain types of coat patterns will not produce either a few spot or snowcap but are conducting further studies. Likewise, we suspect that certain coat patterns necessarily evidence heterozygosity, regardless of pedigree or parentage. Understand clearly, however, that two heterozygous Appaloosa parents can and have produced homozygous horses which, at this point, we have identified as few spots and snowcaps.

While this report focuses only on few spots and snowcaps we believe some other Appaloosa coat patterns or structures may well be homozygous but lack a sufficient data base for justifying any conclusions. Research is on-going.

## **Summary**

We are not attempting to return to the days during which too many breeders ignored quality and bred primarily for color. Nor are we content with some current efforts n which color has become very much a secondary consideration to quality. We believe breeders ought to and can have it both ways. We hope our research will increase the likelihood of achieving it.

These stallions each produced anywhere from 35 to 160 registered foals, involving from 11 to 84 QH/JC/CN/PC/ID mares per stallion. The snowcap stallions produced 100 percent color/characteristics at the time of registration. Several of the few spots produced no more than one or two N/C registered foals, but from a total foal production of 102 and 91 foals respectively.