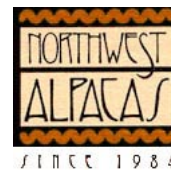




## **The Suri Gene Supreme A Crossbreeding Conundrum**

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By Mike Safley.



## The Suri Gene Supreme A Crossbreeding Conundrum

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The idea of crossbreeding suris with huacayas is controversial. The concept creates cognitive dissonance. Many, maybe most of you, may not like the ideas presented here. Don Julio Barreda, a man I greatly respect, has made clear that, in his opinion, the suri breed should not be crossbred with huacayas. In the past, a huacaya with a suri parent in its pedigree has been less valuable than a similar animal without a suri parent. These crosses were considered impure or intermediate.

But what if the suri gene is dominant and found at a single location on the alpacas DNA map. What if suris and huacayas from crossbred parents were as pure as any other alpaca? The ramifications are significant. It would mean that the suri herd could be multiplied at will simply by transferring the gene for suri phenotype to cria of huacaya females. Colored suris could be created by design. The suri breed, as a whole, would benefit from the hybrid vigor generated when two separate breeds are mated. There would no longer be any fear of a shortage of suri genetics.

There is sound scientific evidence that the suri gene is dominant. There is also ample anecdotal evidence from several suri breeders in Australia that supports the proposition that the suri gene is dominant. The importance of this discovery should not be ignored.

### THE SCIENTIFIC RESEARCH.

Dr. Raul Ponzini of the South Australian Research and Development Institute used Mendel's classic theory of dominance to postulate that the suri gene was completely dominant over the huacaya gene and that it was simply inherited. He reported the following results in the scientific paper entitled Phenotypes Resulting From Huacaya by Huacaya, Suri by Huacaya, and Suri by Suri Alpaca Crossing.

Data on 145 Huacaya sire by Huacaya dam, 24 Suri sire by Huacaya dam and 35 Suri sire by Suri dam mating records (and their corresponding progeny) were used to determine the mode of inheritance of the Huacaya and Suri feature in Alpacas. The results indicated control by a single gene (or by a haplotype), and dominance of the allele responsible for the Suri type (AIFs) over that responsible for the Huacaya type (AIFh). (For the purposes of our discussion (AIFs) = (SS) and (AIFh) = (ss)).

It is important to understand that the basis for the determination that the cria from these matings were suri was the phenotype of their fiber. Huacaya crias have a voluminous crimped fleece that grows perpendicular to the skin like merino sheep wool. Suri fleece is spiral locked, compact, and hangs in long ringlets from the skin, much like an angora goat. Suri fleece is also characterized by high luster. The experiments reported here were based exclusively on fleece phenotype, which is also how breeders distinguish a suri from a huacaya.

Ponzini discusses similar studies reported by Nova and Wilson (1992) and Flint (1996). In the Nova and Wilson study all huacaya by huacaya breedings produced huacaya offspring, which was consistent with Ponzini's conclusion that huacaya were the result of double recessive gene pairs (ss) at a single location on the DNA. Flint's study reported that out of 8,446 huacaya by huacaya matings there were twelve suri offspring. Please note that if huacaya by huacaya matings produce suris, Ponzini's theory that the suri gene is dominant at a single location would be false.

Follow up investigations of the Flint observations found that suri males were present at each property which reported huacaya by huacaya matings producing suri offspring. In several of these instances,

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blood typing established that a suri male was indeed the sire. Unfortunately, not all breeders allowed the crias in question to be bloodtyped. Ponzini ended the discussion of his findings with the following statement:

We conclude that our results are consistent with the postulated mode of inheritance (a single gene and two alleles, AIFs dominant over AIFh). The model was chosen because it is the simplest possible one. Note, however, that the same results could be obtained if the trait were not controlled by a single gene, but by a group of very closely linked genes (haplotype) that were inherited together. Further analyses of data should contribute to a greater understanding of the genetic mechanisms involved in the expression of the huacaya and suri phenotypes.

The practical effect of Ponzini's theory is that suri offspring will be produced 100% of the time if a homozygous suri male (SS) is mated to a huacaya female (ss). A heterozygous suri male (Ss) will produce 50% suri cria and 50% huacaya cria when mated to a huacaya female (ss). Mating two heterozygous suris (Ss) will produce 75% suri and 25% huacaya. In all instances, the huacaya produced from these matings will be 100% homozygous huacaya (ss).

### THE CONVENTIONAL WISDOM.

If Ponzini's theory is true, why is it the conventional wisdom, particularly in South America, that the huacaya is the dominant breed or gene? This misconception probably has more to do with gene frequency than dominance. There are more huacaya than suri. Mother Nature also plays a role and suris have been selected against environmentally. There is higher mortality for suri cria than huacaya cria at higher, harsher, colder elevations in the altiplano. Suris prosper at lower elevations in milder conditions. Few, if any, alpacas are grazed below 9,000 feet above sea level in Peru, where the majority of the world's suris reside. .

In Peru, suris at the larger co-ops are often run separately. At Rural Alianza, for instance, almost all of their suris are bred at Antacalla near Nunoa. Peruvian breeders simply may not have noticed suri dominance. In the United States, most breeders have avoided cross breeding suris with huacaya. In Australia, several breeders have been concentrating on crossing suri with huacaya and their results substantiate Ponzini's single gene dominance theory.

### THE GENETICS OF SURI GENE DOMINANCE.

Gregor Mendel, the father of modern genetic science, was a pea breeder. He found that inheritance was essentially the algebra of one-half. He postulated that dominance, not mutation, explained progeny with varying phenotypes from the same parents.

Mendel discovered that the way a gene expresses itself at a locus depends on the other gene present at the same locus. His pea plants were either tall or extremely short. He called the short variety dwarfs. The dwarf plants were (tt) genotype and the tall plants were either (TT) or (Tt). The gene for shortness (t) only produced a dwarf when paired with another (t) gene. Yet when the same (t) allele was paired with a tall (T) allele, the plant was not intermediate in size as you might expect. It was just as tall as the (TT) plants -- the (t) allele appeared to have no effect at all. Today we say that the (T) allele is dominant and the (t) allele is recessive.

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Dominant alleles or genes are usually represented by an uppercase letter and recessive alleles by a lowercase letter. For instance, at the (A) locus, the (AA) genotype is called the homozygous dominant genotype, the (Aa) genotype is the heterozygous genotype, and the (aa) genotype is the homozygous recessive genotype. The letter or letter combination chosen to represent a locus is usually an abbreviation related to the characteristics of the dominant gene. That is why Mendel chose (T) for tall. Please remember, for the purpose of this discussion, the suri gene will be referred to as big (S) and the huacaya gene a small (s).

In Mendel's peas, the mode of gene expression at the (T) locus was complete dominance. This is the classic form of dominance in which the expression of the heterozygous genotype is no different from the expression of the homozygous genotype having two dominant genes. (Tt) heterozygotes and (TT) homozygotes were equally tall; phenotypically they were undistinguishable from each other. Complete dominance is common in a number of simply-inherited animal traits. .

An example of complete dominance in cattle is the polled trait, the (P) allele for polled is completely dominant over the recessive (p) allele for horned. Another example is the Angus beef cattle which can be either red or black, but the (B) allele for black is completely dominant over the b allele for red. Single gene, single location dominance of the suri gene is analogous to the dominance of the (P) gene for polledness. A polled, or hornless, bull who is homozygous for the polledness gene will produce calves with no horns from mothers with horns, every time.

Why is the phenomenon of dominance important to animal breeders? The first reason relates to simply-inherited traits like the ones Mendel studied in his peas. For these traits, dominance explains why we get various phenotypes in particular proportions when we make specific matings. Understanding the nature of dominance in these situations allows us to predict the outcomes of matings. The second reason involves polygenic traits or traits affected by many genes with no single gene having dominance. Polygenic traits allow for the expression of hybrid vigor. The current scientific evidence strongly suggests that the suri gene is a simply inherited, completely dominant trait.

### SIMPLY-INHERITED AND POLYGENIC TRAITS.

Most economic traits in animals are polygenic in nature. Some traits, however, are simply-inherited. Because simply-inherited traits are influenced by only a few genes, selection for these traits is different from selection for polygenic traits. With simply-inherited traits, breeders do not deal with breeding values and their predictions, or even with concepts like heritability (see Pure Blood, Part II). In the case of selecting for the suri gene, the breeder would be interested in whether the alpaca was a suri or a huacaya and, if a suri, whether it was homozygous. .

There are two common secondary characteristics of simply-inherited traits. First, phenotypes for these traits tend to be "either/or," they are categorical in nature. An Angus is either red or black and a cow is either horned or polled. Second, simply-inherited traits are affected very little by environment. A polled cow that spends a lot of time in the sun will not grow horns. .

In contrast, polygenic traits are affected by many genes, and no single gene has an overriding influence. Examples of polygenic traits include fleece quality, growth rate, milk production, and time to run a given distance. Geneticists know very little about the specific genes affecting these traits and can only conclude that there are many of them.

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Phenotypes for polygenic traits are usually described by numbers. Breeders speak of 500-lb weaning weights in cattle, 30,000-lb lactation yields in dairy cows, 20-second times in the quarter mile for quarterhorses, and 16 micron fleeces for alpacas. Instead of being “either/or” in nature or falling into a few distinct categories as phenotypes for simply-inherited traits do, phenotypes for polygenic traits are typically quantitative or continuous in their expression. Polygenic traits are clearly affected by the environment. If cows, pigs, sheep, and alpacas are fed less, they grow more slowly and produce less milk, meat, or fiber. If horses are not well trained, they do not run as fast.

Most, if not all, fleece characteristics are thought to be the result of polygenic inheritance. Density, fineness, crimp, staple length, luster, and sheen are all influenced by multiple alleles or genes. But the suri gene is most likely a simply inherited trait and it determines only the progeny’s suri phenotype, which is defined by its fleece style.

### CROSSBREEDING SURIS WITH HUACAYA.

Crossbreeding is the mating of two animals which are both purebred but belong to different breeds. Crossbreeding, like any other form of outbreeding, tends to lower the breeding value of the progeny by making them more heterozygous and make selection among the crossbred individuals less effective. When crossbreds are used for breeding purposes, their offspring are more variable than the crossbreds themselves. Often the quality of the progeny of crossbreds is distinctly skewed. A few exceed the average of the purebred parents, but many are below average.

Typically, a cattle or sheep producer will crossbreed pure strains of cattle or sheep to produce a commercial market animal. An alpaca cross breeding program would be more similar to the traditional grading up programs used in the purebred cattle industry. Grading up is the cheapest, most efficient way of changing the population of a certain breed of animal into another breed of animal, in this case, huacaya to suri. .

Suris that will breed true can be rapidly created from suri/huacaya crosses by simply following a strategy of repeated back crosses. This would mean always breeding the female product of suri/huacaya crosses back to a suri male. Backcrossing is the practice of mating a crossbred animal back to one of the purebred parents of the breed which were initially used in the cross. It is a term commonly used in genetic studies but not widely used by breeders. .

When repeated backcrossing is used to import a specific allele, such as the suri gene, the population that lacks the allele, in this case the huacaya, is crossed with a male which possesses the allele, in this case a suri male. The successive generations of female offspring would be backcrossed to homozygous suri males. After a number of generations, almost all of the genes in the population will trace back to the suri and the offspring will be homozygous for the suri gene. At this point, further backcrossing is no longer needed, and matings can be made within the new population. .

### THE PUNNETT SQUARE PICTURES PURITY.

Webster’s dictionary defines a conundrum as: a riddle whose answer is or involves a pun. The answer to the riddle of crossbreeding suris and huacayas involves a Punnett Square. To understand how, we must first go through some basic genetics. Please do not be put off by the technical nature of the following description. The answer will become clear.

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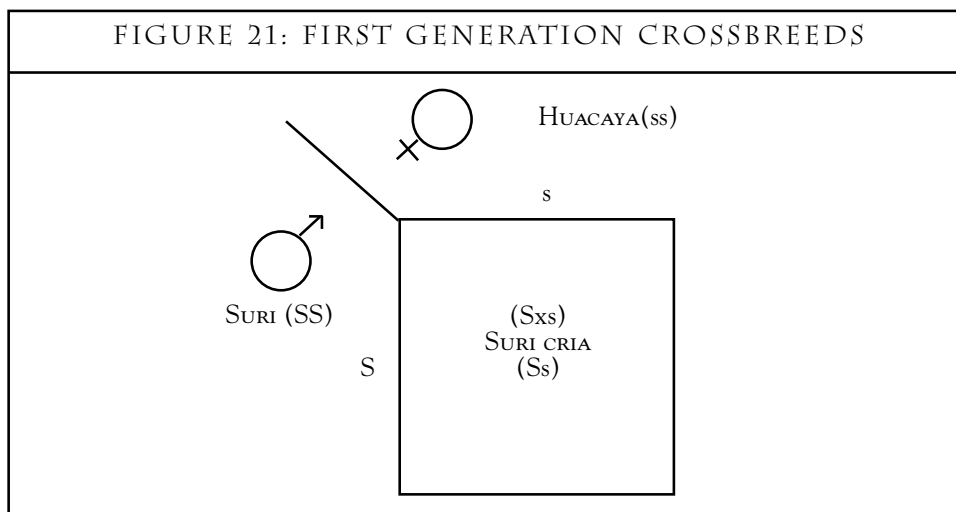
When a male is successfully mated to a female, sperm and egg unite, and an embryo is formed. In geneticists jargon, they say that gametes from the sire and dam combine to form a zygote. Zygotes are offspring. They have the normal number of genes and chromosomes, half from the gamete contributed by the sire, and half from the gamete contributed by the dam. The process that determines which egg matures and which sperm succeeds in fertilizing the egg is called gamete selection. The selection of gametes is random. .

A commonly used device for determining the possible offspring obtainable from the mating of any two parental genotypes is the Punnett square. A Punnett square is a two-dimensional grid. Along the top of the grid are listed the possible gametes from one parent, and along the left side are listed the possible gametes from the other parent. Inside the cells of the grid are the progeny that are possible from the mating. They are obtained by simply combining the gametes that head each row and column of the square. .

By using the Punnett Square, it is possible to determine the probability of any particular offspring genotype occurring by noting the frequency of the cells that contain that genotype. And if you know what phenotype is associated with each genotype -- as is the case with the suri or huacaya -- you can also determine the expected proportions of offspring phenotypes and, in this case, what proportion will be homozygous for the suri gene (SS).

F-1 (FIRST GENERATION).

Consider how this process would work beginning with a purebred or homozygous suri male (SS) and a purebred homozygous huacaya dam (ss). .

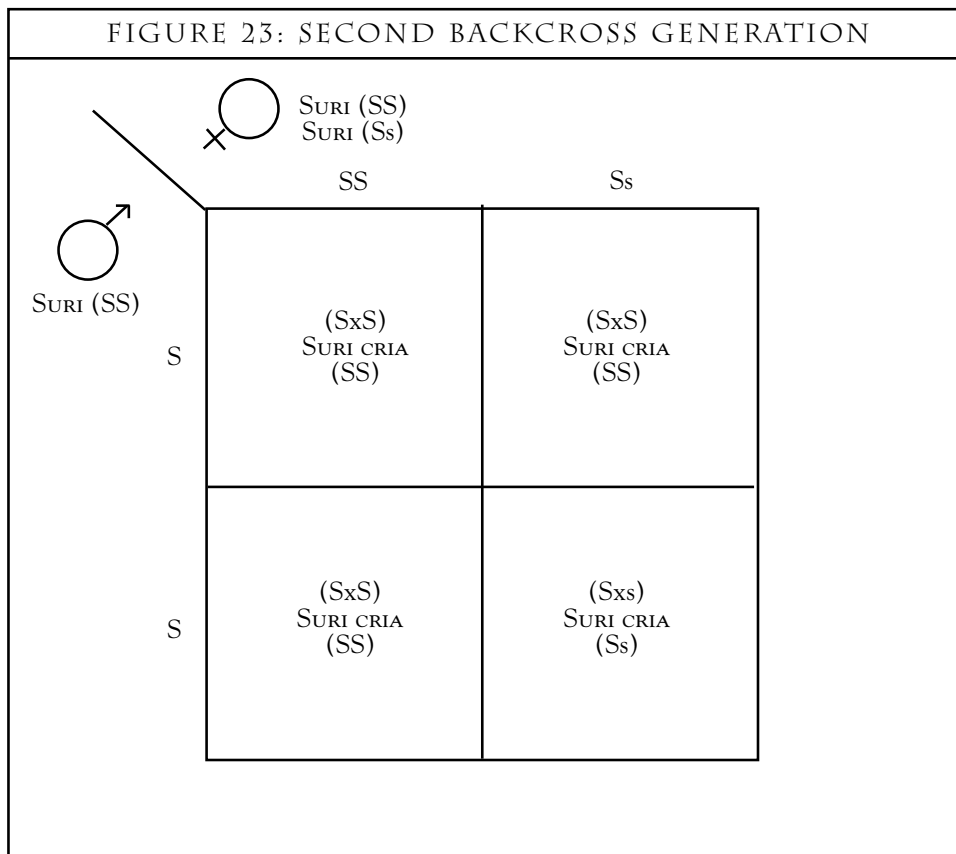
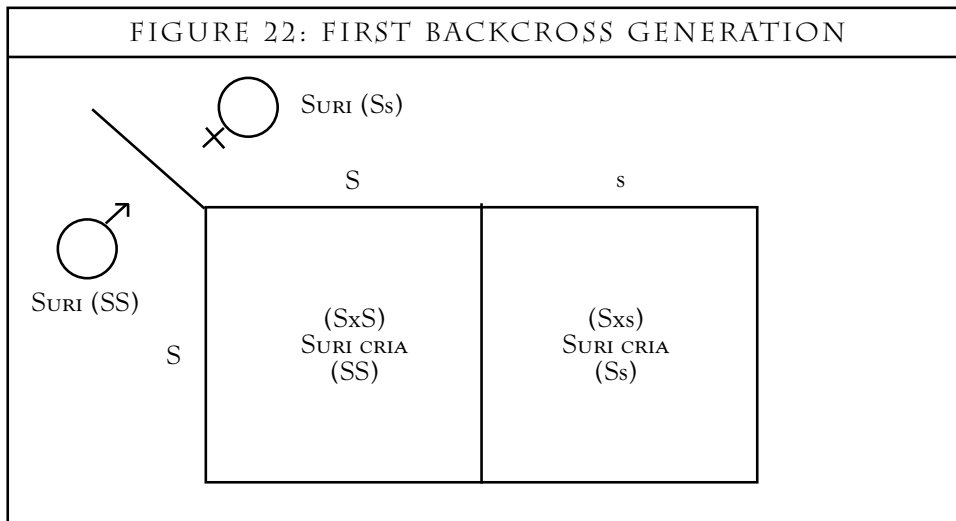


All the crias resulting from this mating would be heterozygous Ss, and because the suri allele (S) is dominant, they would all be suris. .

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### BC-1 (FIRST BACKCROSS GENERATION).

In the BC-1 generation, the heterozygous (Ss) first generation suris, F-1, would be backcrossed to a homozygous (SS) male, they would produce progeny which were 100% Suri phenotype with 50% heterozygous and 50% homozygous suri genotype.



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In the BC-2 generation the BC-1 suris, half of which are homozygous and half which are heterozygous, would be backcrossed to homozygous suri sires, they would produce progeny that were 100% suri phenotypes and the cria would be 75% homozygous suri genotype. .

Continuing on, if suri females from the second backcross (BC-2) generation were backcrossed again to homozygous suri sires, creating a BC-3 generation, they would produce 100% suri phenotype with 87.5% of the offspring homozygous for the suri gene. Backcrossing and selection for the suri allele could continue for another generation when the proportion of pure or dominant suri in the population would be sufficiently high, say 15/16 or 93.75%, for these suris to be mated among themselves. They would generally breed true to produce predominantly suri progeny.

Because the huacaya allele would still be present in the new suri population, as it is in the current population, breeders of suris should continue to cull sires which produced huacaya offspring from suri x suri matings. Among suri breeders, proven homozygous suri sires would be especially desirable because they would not produce huacaya offspring. .

### HOMOZYGOUS MALES.

The use of homozygous males in an alpaca crossbreeding or grading up program is the key to rapidly creating suris that will breed true. The use of heterozygous males (Ss) would retard the process by increasing the frequency of the recessive huacaya genes (s).

How do we determine whether a suri male is homozygous or heterozygous? There are currently no genetic tests available which will make this determination, although there may be in the future. The solution, though, is relatively simple. Breed a suri male to huacaya females. If he sires any huacaya crias, he is heterozygous.

Suri males which are bred from many generations of suri parents have a higher likelihood of being homozygous. F1 crossbred suris from huacaya dams will automatically be heterozygous. Mathematically, any suri male is likely to be homozygous if he produces six suri crias from six huacaya matings. At eleven matings and eleven suri offspring, it is better than a 95% probability that a male is homozygous (SS) for the suri gene. After twenty successful combinations, it is virtually certain that the male will always breed true.

### HYBRID VIGOR.

Hybrid vigor is defined as an increase in the performance of hybrids over that of purebreds, most noticeably in traits like fertility or survivability. Hybrid vigor is not caused by the presence of particular genes in an individual, but the presence of particular gene combinations. While the purpose of selection is to increase the proportion of favorable genes in future generations of a population, the purpose of mating for hybrid vigor is to increase the proportion of favorable gene combinations in a population.

Mating a Charolais to an Angus is an example of crossbreeding which produces hybrid vigor. Charolais are large French cattle known for fast growth and heavy muscling. Angus are smaller British cattle known for their maternal ability. Their crossbred offspring benefit from the hybrid vigor of having both kinds of parents. .

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The more unrelated two breeds or lines are, the greater the hybrid vigor expected in crosses between them. Two individuals from closely related populations are likely to be homozygous at many of the same loci. When these individuals are mated, their offspring are often homozygous at those loci. Their offspring are not particularly heterozygous, and little hybrid vigor is observed. In contrast, if two individuals from unrelated populations, such as the suri and huacaya are mated, they will not be homozygous at many loci. For example, if one individual's genotype at the (B) locus is (BB), and the other individual's genotype is (bb), when these individuals are mated their offspring are heterozygous (Bb), and hybrid vigor results. This is especially important when you consider that most dominant genes are expressed as positive characteristics.

Hybrid vigor is a powerful genetic tool. The hybrid vigor obtained by crossbreeding huacayas and suris will most likely create some pleasant genetic surprises. For instance, the huacaya cria produced could have more lustrous fleeces and suri could regain their full range of color. There may also be other favorable gene combinations that are not readily apparent.

### THE AUSTRALIAN EXPERIMENT.

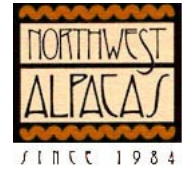
The science of genetics is often abstract and, at first blush, does not always reveal its ultimate wisdom. I have followed the suri/huacaya cross issue for years. Intuitively I resisted the idea of crossbreeding. My resistance was based on the misconception that the product of suri/huacaya mating would be an inferior or intermediate cria that would not exhibit the finest qualities of either breed.

To see the practical results of a theory, on the ground, is the ultimate proof. Sandi Keene, Roger Haldane, Wendy Billington, Paul Carney, and Jill Short are Australians who have demonstrated, in their herds, the proof of Ponzini's suri gene dominance theory. A visit to their ranches makes a convincing case for crossbreeding.

Sandi Keane has been breeding suris since 1995. She was one of the first Australians to own suris, particularly colored ones. Sandi began crossbreeding before Ponzini's study. Her original goal, interestingly enough, was to add luster to huacaya fleeces. She also believed that she might reduce medulation in the huacaya cria she expected to create. Her first matings produced about 50% huacaya and 50% suri cria. The huacaya cria were superior specimens. The suri male she was using was obviously heterozygous, or (Ss), for the suri gene. The suri cria she initially produced were of medium to poor quality.

Sandi then began to use a Bolivian suri sire, Byron, she had acquired from Billy Borhdt. Byron was a phenotypically superior, white male with dense, penciled locks from head to toe. Surprise, Lord Byron produced only suri cria. His progeny were silver grey, black, red, white, and multi-colored -- over twenty five to date, no huacayas. Byron is obviously homozygous (SS) for the suri gene.

Sandi also used a black suri male named Silquestra, but he was obviously heterozygous (Ss) and produced fifty percent suri and fifty percent huacaya. From the cria he has sired to date, he has produced two silvers and eight blacks, all from black females. Several of the black suri cria were drop dead gorgeous.



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Roger Haldane is a legend in Australia. He almost single handedly created the Australian alpaca industry by organizing the first major import of alpaca into Australia. He has raised prize winning fine wool merino sheep and angora goats. The alpacas bred from Roger's Purrembette stock have dominated the Australian show ring for years. Roger has recently imported milking buffalo into Australia from Italy and Bulgaria. His mozzarella cheese made from the water buffalo milk is currently served on Qantas airlines and in most of Australia's fine restaurants. Roger and his brother, Clyde, selected the first Peruvian alpaca imports into the U.S. and Roger is currently crossbreeding suri males with huacaya females.

Why are you crossbreeding, I asked? "You can put the entire suri clip in one bag and sell it all for the same high price," replied Roger. "I have bred one suri male to over sixty huacaya females and I have not had one huacaya cria yet. The crosses are about 25% superior, 40% medium, and 35% lesser quality." Roger added that he expected the quality of the cria from the F1 generation to increase considerably when they are backcrossed to suri males. The suris at Haldane's Purrembette Farms range in color from silver to white and from fawn to dark chocolate. The quality of the huacaya females Roger is using is very poor, but his suri males are exceptional. One of the crossbred offspring was a beautiful, lustrous, silver grey suri male, which would probably bring \$100,000 at auction in the United States.

Paul Carney, another Australian alpaca breeder, made the following comments about crossbreeding suris with huacayas in the Winter 1997 issue of the Australian magazine *Town and Country Farmer*.

"... Before we began this project the information available from South America did not confirm any simple mode of inheritance so that we were surprised when our crossings produced very large numbers of suri.

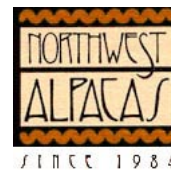
"Our next surprise was that the suri outcome of a huacaya suri cross was indistinguishable from so called pure suri from South America and the huacaya outcome of such a cross was indistinguishable from huacaya, there being no evidence of intermediate types.

"Our findings were no different from that observed over a range of farms. The genes responsible for the suri or huacaya types appear to be very closely related. The suri strain is dominant, in other words, where the suri gene and the huacaya gene are present in the same animal, then the animal will be phenotypically, that is to say in every outward appearance, a suri...

"Some people are bound to ask how we can be so certain about this outcome. The answer is that we can't be absolutely certain, but there has been a careful statistical analysis which indicates very high levels of probability for these outcomes and which is consistent with other data ...

"As to the future, I think that depends very much on the kind of fibre which has the best market. My own experience has been that I have been able to produce not only suris, but also better huacaya by working in this way.

"Since the suris were a rare group of animals it is possible that other genetic attributes locked up in that group will make a significant difference in ways other than the straight forward suri/huacaya difference. There may, for example, be some genes for fineness and lustre restricted to the suri group."



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Wendy Billington was also one of the first Australian suri breeders. I met Wendy in Charlevoix, Michigan at the 1993 Peruvian Legacy Sale. She purchased her first suris through me, after inquiring “what are those beautiful creatures?” Today, Wendy has one of the foremost suri breeding studs in Australia, where her animals regularly win grand championships. She made the following comments about crossbreeding suris in the July 1998, Australian, Suri Club News.

“The main reason why we believe in cross breeding is to increase the number of Suri females in Australia, particularly the coloureds. Coloured Suris are extremely rare in Peru and are impossible to import due to strict quotas and tough screening standards (coloureds are less likely to pass the fleece criteria). (Ed. there are a small number of coloured Suris available in the USA but prices are very high, averaging around \$A60,000 and another \$10,000 to import it to Australia!). However, we caution those breeders interested in cross breeding that the first cross does not always deliver the lustre, staple length or lock architecture of the true Suri so it is important to return the female to superior Suri males with a pure line in their background. We do not regard males from the first cross to have much value as herd sires as their genetic background would be unreliable. Furthermore, it must be remembered that the one elite quality that Suri has is the drape, lustre and silkiness of the fibre. This must always be the optimum in breeding up from cross breeding. Otherwise, you will have fibre of little value.

“We don’t advocate cross breeding randomly without consideration given to the female in question. Perhaps it would be best to start with a loosely fleece huacaya which has little value in your herd. Try to find a dominant Suri sire to ensure your greatest chance of producing Suri progeny. Experiment cautiously and get some advice from experienced Suri breeders -- particularly those who have been experimentally with cross breeding.”.

Jill Short owns suris and she manages suris for Alan Hamilton, who is the two time past president of the Australian Alpaca Association. Jill also crossbreeds suris and huacayas. When I asked her why crossbreeding was controversial in Australia, she gave the following explanation:

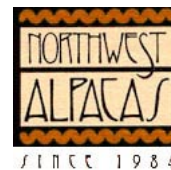
1. Breeders often have an emotional response and don’t really understand how it all works.
2. Some people are afraid of losing the pure suri line.
3. The market place is very interested in crosses here in Australia.

All the points above would probably hold true in the United States. The main difference between the U.S. and Australia is there are far more suri in the United States. Quality, rather than quantity, would most likely be a larger issue in North America.

### CROSSBRED QUALITY.

Raul Ponzini’s study made me rethink the entire question of crossbreeding. A review of genetics texts lead to the conclusion that adding hybrid vigor, expanding the gene pool, and increasing selection variability are all additional benefits to be gained from crossbreeding suri and huacaya. I also came to realize that crias from crosses need not be inferior.

I judged an alpaca show on a recent trip to Australia. The suri I gave best in show was a cross. I did not know that this was the case until I was talking with the owner after the show. The suri was from a high quality Peruvian huacaya parent.



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Most alpaca crossbreeding has been done using high quality suri males and low quality colored huacaya females. This combination produces a higher percentage of lower quality suris than would normally occur in suri to suri matings. This does not necessarily have to be the case. .

When I purchased my first dozen Peruvian females in 1993 my son, Charlie, chose as his personal alpaca, and college tuition investment vehicle, one of the nicer females in the lot. He named her Peggy after his grandmother. She was pregnant when we bought her, the mating having taken place in Peru before she was shipped. Charlie and I delivered Peggy's first cria and amidst all the excitement Charlie stopped, became quiet, and said, "Dad, that baby is a suri." He was right.

We named the cria Charlie's Angel. When she was six months old we began showing her. She never lost, winning the blue ribbon at AOBA's national show in Estes Park, Colorado. The next year she was pregnant, so we sheared her and took the fleece to many fleece competitions and won more blues. I began thinking about "Angel" as I researched genetics texts for crossbreeding information.

In theory, a cria from a huacaya dam and a suri sire could inherit the phenotype from the male simply, and density, fineness, and staple length genes from the dam polygenically. This would mean that the higher the quality of the huacaya dam, the higher the quality of the suri cria. The sire, of course, would also exert considerable influence on the quality of the cria and hybrid vigor could play a part.

Common sense says that a polygenic trait like density could be transferred from a huacaya dam to a suri cria. Density is largely a matter of the number of fiber follicles per square inch of skin. If both the sire and dam have high follicle counts, it should follow that the cria would likely be dense, just like the parents. Another polygenic character, like fineness, could easily be transferred independent of the simply inherited suri gene. Bottom line, there is no apparent genetic reason that suri crosses need to be of any less quality than cria from suri x suri breedings. .

### RECLAIMING COLOR FOR SURIS.

Crossbreeding suri males with colored huacaya females would allow breeders to quickly recover color diversity for suris. Color has a distinct impact on the price of breeding stock and fleece. Suri breeders currently have to pay a large price premium to acquire color. By understanding the principals of crossbreeding, this no longer needs to be the case. Herds of suris in every color are only a generation away.

The addition of a broad range of color to the suri herd at affordable prices would significantly broaden the market for suri breeding stock. The availability of rare colored suri fleeces could not help but increase the attractiveness and price of the fiber to end users.

### THE ECONOMIC SIGNIFICANCE OF CROSSBREEDING SURI AND HUACAYA.

Think for a moment about owning a source of production that could provide product to two markets, each of which would pay a different price. You would likely sell to the highest bidder, always taking advantage of the particular market with the highest price structure. The alpaca fleece market has a dual price structure -- huacaya and suri. The market for breeding stock is also two tiered. Today, for instance, black or silver suris sell for more than black or silver huacayas. Inexpensive, older, colored huacaya females are the perfect vehicle for creating more valuable colored suris.

## The Suri Gene Supreme A Crossbreeding Conundrum

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A huacaya breeder who understands crossbreeding needs to make few, if any, adjustments to channel his production into the most lucrative market, whether it be fiber or breeding stock. The breeder simply chooses a different male to join with his females. A “purebred” suri breeder could capitalize on crossbreeding by supplying homozygous suri males and stud services.

Derek Michell of Michell & Co, Cia in Arequipa, Peru, has been buying suri fleece for years. Today, he pays almost two and one-half times more for suri than huacaya in the altiplano. This has been the case for several years. Recently Derek has noticed a slight increase in the availability of suri fleece. He suspects this could be the breeders response to the price structure. Derek also speculates that the American importers’ willingness to pay higher prices for colored suris may have prompted breeders to breed for suris out of colored huacayas.

The economic implication of crossbreeding for the Quechua herders is significant. An Indian breeder who used a homozygous suri (SS) male could change the percentage of his fleece production from 100% huacaya to, say, a 50/50 split in a few short years. This change, assuming the two and one-half to one pricing disparity held, would increase his gross income by one hundred and seventy-five percent. No small matter in the highlands of Peru, where poverty prevails.

### THE FUTURE.

The future for crossbreeding suris with huacayas should be interesting and, as I mentioned at the beginning of this article, it will probably be controversial. Some breeders will reject the concept in the name of pure blood, others will embrace the idea and breed for pure money. The Alpaca Registry will be of great benefit in this pursuit due to its system of identifying phenotypes and blood typing. Whatever happens, we will always learn more about alpaca breeding if we experiment than if we do not. The crossbreeding conundrum can be solved with a little help from the Punnett Square.