What is a pure suri?

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When I was approached to write an article to discuss the question "what is a pure suri", I thought the issue could be dealt with in a few words. After reflection, I realise this question cannot be answered without first answering another question: What is a suri?

What is a suri?

There is a great deal of confusion about the use of the word suri. In effect it can have at least three different meanings. In the alpaca breeding industry, it can refer to (i) a fleece type, (ii) an animal type or (iii) an animal breed. The limits of each meaning are quite blurred and actually overlap as will be shown below. The confusion is reinforced by the existence of llamas with coats, which resemble the alpaca suri fleece type, and are called "suri llamas". Similarly, the Australian Alpaca Association (AAA) made the decision to accept for registration as a suri (type) any alpaca that exhibits fleece with some kind of locking. This also contributes to the confusion about the meaning of the word suri.

Suri as a fleece type

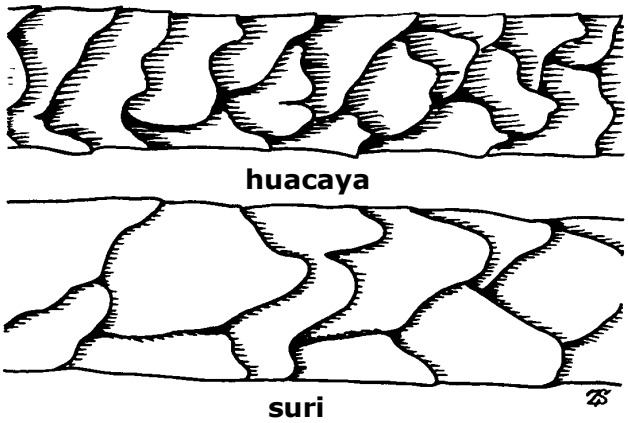
Suri as a fleece type is actually well defined and a concept easy to understand. The word "type", that the AAA has decided to use, is well chosen indeed. It is an abbreviation for phenotype. Suri type fleece can be succinctly described as a fleece that hangs down in locks. The AAA standard (revised in June 2002) describes it in great length and the reader is referred to the official text for a complete detailed description [1].

Whether the expression of this fleece phenotype is governed by only one gene, with two alleles (S and s) or by several genes or by more than two alleles has been discussed separately [2, 3]. This is beyond the scope and the point of this article. From now on, for ease of discussion, it will be assumed that only one gene governs fleece type in alpacas: [SS] and [Ss] give a suri type and [ss] gives a huacaya type. S is therefore completely dominant over s. This model fits very nicely with the vast majority of pedigree records [2].

Suri as an alpaca type

Some suri breeders are of the opinion that any alpaca exhibiting the suri fleece (pheno)type referred to above is, by definition, a suri. In that respect, they are fully in line with the AAA approach.
On the other hand, other breeders consider that suri alpacas differ from huacaya alpacas in more characteristics, including physiology, morphology and even behaviour. For example:

- Suris are stronger and generally more robust than the huacayas. They are the last to lose weight in tough times, do well on the poorer pastures and need less medical attention [4].
- The males are more virile and the females breed more readily [4].
- They have a longer life span [5].
- Suri hair grows one to two centimetres per year more than huacaya [1, 5].
- Annual fleece growth for suri is 20 cm and for huacaya 15 cm [6].
- The ideal suri exhibits little medullation, resulting in uniformity throughout the fleece [1, 7].
- Site sampling and testing on suris indicated the fleece to be more even for micron over the body [8].
- Suri fleece is much more lustrous and softer [many references].
- Compared to huacaya, the scales on suri fibre are thinner, one-directional and smooth-edged, and the only fibre softer than suri is vicuña (see illustration below). The uniform direction and tight edges of the scales account for its slippery feel. Suri fleece is cleaner than huacaya fleece [6].



Microscopic scale structure of huacaya fibre compared to suri fibre [6]

These two very different opinions perfectly illustrate the confusion about the word suri. Is it simply a fleece type or is it an animal breed?

It is also quite obvious that a simple gene with just two alleles (S and s) cannot possibly be responsible for all the differences between suris and huacayas, listed above.

Suri as an alpaca breed

A breed is an entity within a species. Individuals of the same breed resemble each other and, when mated together, produce animals, which also exhibit the same phenotypes, characteristic of the breed to which they belong. This is often characterised by saying that these animals "breed true". In the present state of the AAA register, suri is certainly not considered an alpaca breed, as will be discussed further below. Suffice to say that the mating of two suri phenotypes does not always deliver a suri: two heterozygous suris [Ss] mated together can produce a huacaya [ss] with a 25% probability. Therefore they do not "breed true". The AAA register is not a breed register. It is the repository of the genealogy for the majority of Australian born alpacas, and a few alpacas born overseas.

Most of the time, a breed is an artificial concept created and perpetuated by humans. How well a given breed is defined is up to the breeders. These breed definitions are called breed standards.

At present the official AAA standard for the suri, as an animal, relies mainly on fleece characteristics. The only suri characteristic not related to fleece in the AAA standard is a recent addition (June 2002): " Suri ears can be up to 2 cm longer than huacaya ears" [1]. Basically, the AAA standard defines (i) what an alpaca should look like morphologically, (ii) what the huacaya fleece type should look like and (iii) what the suri fleece type should look like. In its present state, it mainly asserts that alpacas (both suri and huacaya) should be, well, alpacas, with not too much evidence of the presence of llama genes. It then defines two fleece types in great detail: the huacaya and the suri. This approach falls very short of a proper standard for a breed. It is simply a species monograph, which allows for variation in fleece phenotype.

Breeders who believe that suris are a breed and exhibit many characteristics that are not only different from those of huacayas but also well worth preserving and perpetuating, would not be happy with such an unrefined standard.

Paradox in the present situation

It is very paradoxical that the AAA standard defines fleece types in such great detail, whereas it is very vague indeed as far as morphological characteristics are concerned.

Why bother about morphology? After all, alpacas are essentially bred for fleece production and therefore it should not matter whether they have long or short ears, a long or a short face, are compact and round or slim and elongated…

It actually matters, for two reasons.

First it matters that our animals are well balanced and built in a way that they will be able to live a healthy life. This aspect is somewhat covered by the present

standard, which lists a series of faults and disqualifying defects. The list is not perfect but it is a start and it is a good thing that the AAA made provision for such faults and defects to be listed in the standard. It is surprising however that these standards are only enforced during male certification. Any other alpaca (female, wether, male not destined to produce progeny to be registered but which can still be used to produce commercial animals) can be registered by the simple fact that they are born from registered parents - another paradox.

The second reason why it is important to consider morphological traits in a standard is due to what we call “genetic linkage”. What does this mean? Let us take a completely hypothetical example, where suris with the finest fleece tend to have longer ears. I do not know if this is true or not but this is just to illustrate the point. The reason would be that genes that are responsible for fineness are inherited together with the ones responsible for long ears, either because they are actually the same (unlikely in our example) or are located on the same chromosome, particularly if they are close to each other on the same chromosome. The presence of long ears is then said to be genetically linked with fineness. We could almost say that long ears are a marker for fineness. So why not use these indirect markers as part of the standard? This will help breeders select for animals that are indeed “true to type”, as some of these markers (long ears in our example) are much easier to observe than the characters they are linked with (fineness in our example).

To finish this part about the paradoxical situation we are in, I must mention how surprising it is that the AAA standard was very carefully drafted so that the presence of llama genes in our alpacas would not be accepted (Roman nose, banana ears, straight back line, oversize are all negative characteristics), whereas it failed to take into account the obvious morphological differences between huacayas and suris.

Let us summarise the discussion:

- The AAA seems to have decided that suri is simply a fleece type.
- The AAA standard is not a breed standard.
- The AAA register simply records the ancestry of Australian-born alpacas.
- Suri as a breed is not clearly defined in any readily available publication.

What is a pure suri?

Let us now try to answer the initial question: what is a pure suri?

If, like the AAA, you believe that suri is a fleece type, it is very tempting to say that a pure suri is an alpaca homozygous for the S gene [SS]. Some breeders have told me that this was their definition of a pure suri, no matter how this alpaca has been produced and no matter how many suris or huacayas there are in its ancestry.
I will now try and explain why I believe this is very shortsighted indeed.

The S gene and the suri fleece

If an alpaca is [SS] or [Ss], it exhibits the suri fleece type. If it is [ss], it's the huacaya type. However, one single gene cannot, by any means, be responsible for all the characteristics that make a suri fleece a (good) suri fleece. The low level of medullation, the high lustre, the higher fibre growth rate, the uniformity of micron over the whole body, all these characteristics that are clearly identified in the AAA standard as suri hallmarks, compared to huacayas, cannot be governed by one single little gene with just two alleles. It is highly likely that the S gene only governs the presence of locks.
Therefore it is not sufficient for an alpaca to be homozygous for the S gene in order to be a pure suri. Let us take an example. A homozygous suri [SS], mated to a huacaya [ss], will give an F1 [Ss], of the suri phenotype. If you mate this F1 to another F1, you will get an F2. In 25% of the cases, this F2 would be [SS] homozygous for the S gene and exhibiting locks. Does that make it a suri? With two huacaya grandparents, this animal has 50% huacaya blood. How can it be labeled "suri"? Let alone "pure suri".
This brings us to the AAA register. In the present state, the AAA register will accept this F2 for registration and it will be classified as suri. It does not matter if its fleece is not in line with the suri standard but just exhibits locks. I do not believe this will help suri breeders achieve very much.

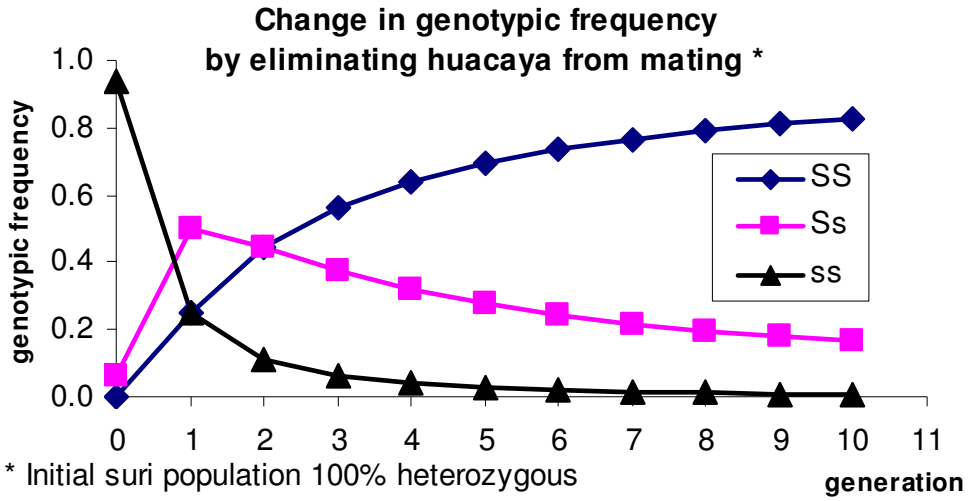
The use of pedigrees or how breeders can change genotypes

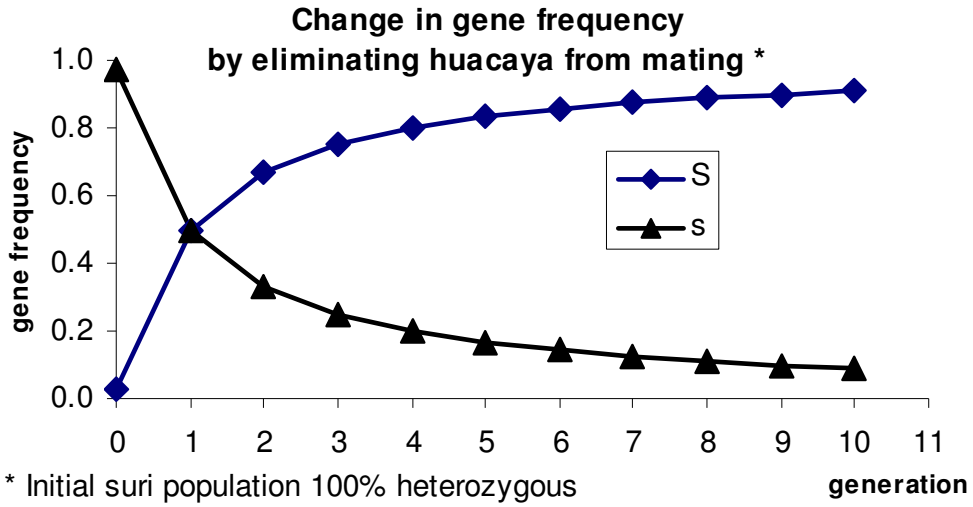
If it is not enough for an alpaca to be homozygous for the S gene in order to be a pure suri, what does it take? It takes a long pedigree of suri ancestors, and this can readily be demonstrated by simple statistics.
We have just seen that all the suri characteristics cannot be governed by one single gene. However, we certainly can use the S allele as a typical example of the kind of genes we want to select for in the suri population.
The explanations, which follow, have already been published elsewhere [9] in September 2001 and are repeated here for the reader's convenience.

It was decided to accept the model, where S is completely dominant over s and where the following combinations result in the following phenotypes:
- [SS] suri (homozygous);
- [Ss] suri (heterozygous);
- [ss] huacaya (homozygous recessive).

In population genetics, two concepts are used:
- **gene frequency**: the relative frequency of a particular form of the gene (e.g. S) in the population;
- **genotypic frequency**: the relative frequency of a particular genotype (e.g. [Ss]) in the population.

The present Australian alpaca population consists of 94% huacayas and 6% suris. This is the phenotypic frequency. As huacayas are the homozygous recessive type, it is easy to deduce that the genotypic frequency for [ss] is also 0.94 (or 94%). Therefore the other two genotypes, [SS] and [Ss], all suris, share 6% of the population. Unfortunately, it is not always possible to determine the proportion of [SS] and [Ss] just by looking at these suris.
If you make the assumption that all the suris in the present Australian population are heterozygous [Ss] - we know this is wrong but it is a handy "worse case scenario" to consider – then, we have a genotypic frequency of 0.94 for [ss] and of 0.06 for [Ss] (and 0 for [SS]). Imagine a group of 500 such alpacas. 470 are huacayas and 30 are heterozygous suris. These animals harbour 1,000 genes, of which 470 x 2 + 30 = 970 are s and 30 are S. Therefore the gene frequency of s is 970 / 1,000 = 0.97 or 97% and the gene frequency for S is 30 / 1,000 = 0.03 or 3%.
Imagine a very simple selection method, where only suris are mated to suris and huacayas are not allowed to reproduce. I hope that my fellow huacaya breeders will not be offended; this is just to illustrate a point. Using this very simple method, the changes in genotypic and gene frequencies can be calculated generation after generation. This is illustrated in the two graphs below.





* Initial suri population 100% heterozygous

As you can see, selection changes both genotypic and gene frequencies quite dramatically. This is actually the whole point of artificial selection. The changes are quite dramatic initially, even when starting with an entirely heterozygous suri population, then the curve tapers and the rate of change rapidly slows down. In fact it is almost impossible to eliminate a recessive allele from a population. So I am quite prepared to see a few huacayas “crop up” in my suri herd from time to time.

More specifically, using the assumption mentioned above, that the initial suri population was 100% heterozygous, it would take:

- 2 generations to obtain as many homozygous suris [SS] as heterozygous suris [Ss];
- 9 generations to obtain at least 80% homozygous suris [SS];
- 10 generations to get less than 1% huacayas;
- 19 generations to obtain at least 90% homozygous suris [SS].

What is true for one gene, is true for the whole set of genes that make a suri a good suri. The S gene was just taken as an example of how whole genotypes can be manipulated by selection. Using pedigrees recording long lineages of animals exhibiting the desired characteristics helps us select relevant populations and progress towards developing homozygous lines and eventually establishing fixed breeds (a fixed breed is a breed where all the relevant genes are homozygous in all the individuals of that breed).

Practical consequences

The careful study of pedigrees will give you an idea of what an animal is worth genetically. This is one of the tools breeders have invented for the purpose of selection. The second tool is the careful examination of the animal's progeny. "The proof is in the progeny". However, this is not always possible, for example in the case of young animals or females, who typically do not produce that many young compared to stud males.

Let us summarise the discussion:

- The presence of the S allele is not sufficient to obtain a good suri.
- The presence of the S allele in a homozygous combination [SS] is not sufficient to obtain a good suri.
- You need to carefully study an animal's pedigree to convince yourself of the purity of the animal you are interested in.

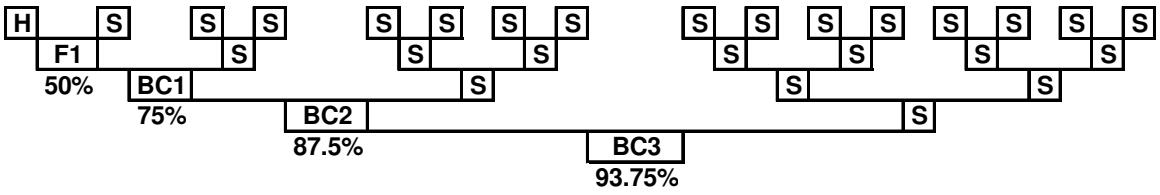
Conclusion

To conclude a rather long discussion, I would like to give my definition of what a pure suri is. It is an alpaca with at least 93% suri blood. Why 93%? Because this corresponds to 15/16 or:

- 2 suri parents
- 4 suri grand parents
- 8 suri great grand parents
- 15 pure suri great great grand parents
- and only 1 huacaya great great grand parent.

One huacaya out of 16 great great grand parents: this is 15/16 suri blood or 93.75%. Such an animal is also called a backcross 3.

As pedigrees stop at the great grand parent level, you therefore need to study the pedigrees of the parents to make sure that there is only a maximum of ONE huacaya "up there". See figure below.



Pedigree of a backcross 3 – The figures in % represent the % of suri blood (H huacaya, S pure suri, F1 first filial generation, BC1 backcross 1, BC2 backcross 2, BC3 backcross 3) – F1, BC1, BC2 and BC3 exhibit the suri phenotype.

This definition is not different from what the majority of breed societies accept in other species, such as cattle for example [10].

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