



## **Blue-Eyed Whites**

*Australian biologist and alpaca breeder Elizabeth Paul considers the influence of colour genetics in the occurrence of this common problem.*

Within the Australian national herd, there are a significant number of blue-eyed white (bew) alpacas. There has been a considerable amount of discussion between breeders as to whether or not blue-eyed whites should be used for breeding, or whether their deafness precludes them from living a normal alpaca life. On the other hand, there has been more than one Australian Supreme Champion blue-eyed white male, which has gone on to a stud career. It is my belief that the gene responsible for producing grey coloured fleece on alpacas is merle, or something extremely similar, possibly in combination with a white-marking gene, like tuxedo [1]. These genes can have an additive effect when combined in a genotype, and may produce what is called a blue-eyed white animal. The material that I have collected indicates that there is a strong connection between grey alpacas and blue-eyed white ones.

### **Summary of the Merle Condition**

The merle pattern in dogs is particularly associated with dogs such as Border Collies, Australian Shepherd Dogs, Shetland Sheepdogs [2], and Cardigan Corgis [3]; but it is also well established in some hound breeds such as Dachshunds [4] and Great Danes. The word merle is a corruption of marl, which in turn is a contraction of marble [2]. The merle gene has a distinctive effect on black or liver pigment in dogs, and the coat of a 'blue' merle dog appears as a silvery or blue-grey background, marbled with splashes or blotches of black. In fact, the dog is genetically black. The eyes may be partially or fully blue, or the dog may have one of each colour. The effect of merle on a red or tan colour base produces a sable merle, which is far less striking in appearance than a blue merle, although they may still have blue eyes. (Matings between blue merles and sables are frowned on in most dog breeds.) The merle causes clumping of pigment within the fibre, like the recessive diluting gene above, and the fibre appears silvery grey. There may be more white in the coat of a merle dog than would be normal for the breed, and the amount of merling can vary considerably between individuals.

Merle M cannot completely mask the non-merle condition, mm, and so an Mm animal appears as an intermediate form, showing characteristics of both alleles, in its coat. For this reason merle is called an incomplete dominant gene [6].

Merle also has an additive effect when combined with the genes controlling white marks. This effect is more pronounced in those breeds which already have white markings.

### **Lethality of Merle**

Matings between two merle dogs are usually prohibited in most breeds, as homozygous merle, MM, is known to be an in utero lethal, like RR roan in horses, However, in dogs, not all MM progeny die before birth. Some are born alive, although they may be born with moderate to severe defects of eyes, hearing and reproductive organs. MM merles are also more likely to be white or nearly white, and to have two blue eyes.

An MM merle, mated to a solid non-merle mm, would produce all Mm (heterozygous) merle progeny. Shetland Sheepdog breeders, among others, apparently used to keep the occasional all-white (presumably homozygous) merle pup for breeding back to non-merle dogs, so they could then produce all merle litters, with very even grey colour. [2].

In my opinion, blue-eyed white alpacas are equivalent to blue-eyed white merle dogs. That is, they are coloured alpacas, overwhelmed by either homozygous merle or the combined action of merle plus white-marking genes.

### **BEW Checklist**

From my own observations, blue-eyed white alpacas are likely to exhibit most of the following characteristics:

1. Two blue eyes, or one blue and one black eye, or parti-coloured blue/black eyes; very occasionally two black eyes. This may be due to the fact that some blue eyes darken over time.
2. Almost certain to be permanently deaf from birth on full blue-eyed side.
3. Patches of pigmented skin particularly on points, ie nose, toes with black pads (toenails may be stripey), spots of black skin down spine, near tail. (Some blue-eyed whites have pink skin and feet). Pigment spots may grow over time.
4. May have very white fleece but with some coloured fibres growing out of pigmented spots particularly along spine, near root of tail and around ankles. Coloured fibre or spots may not be evident in young cria but become more noticeable with age.
5. Often large framed, heavy boned.
6. Both sexes may have fertility problems, or be sterile.
7. Mated to solid coloured mates, they produce a range of coloured cria including greys and/or multi/pinto.
8. Usually have lots of white and/or grey in the pedigree, occasionally also multi/pinto.
9. May have very good fleece characteristics.
10. Usually called Snowflake or Crystal!

### **Problems Deafness**

Dr David Andersen, of Ohio State University has clearly shown in his study that most blue-eyed white alpacas are stone deaf [7]. However, this is more likely to be a

perceived problem for its owner than an actual problem for the alpaca itself. Alpacas are extremely alert animals with superb eyesight, and are very quick to pick up visual cues from their herd mates. They probably rely far more on their eyesight to alert them to danger, than on their hearing. It should be noted that homozygous merle dogs are generally more severely affected in their sight, with reduction of eye size and actual blindness being common. Blue-eyed white alpacas appear to have normal size eyes and see normally, at least in daytime.

## **Fertility**

The bigger issue is that some bew alpacas may have reduced fertility or even be completely sterile. This may be due to various abnormalities of the reproductive system, as noted by Dr George Jackson of Western Australia, in a post to the AAA message board in June 2002. However, most appear to be fertile and can breed normally, despite their deafness. They are not mute, and make the same sounds as hearing alpacas. I have four bew females myself – three of which are certainly deaf. They are all fertile, and are all excellent mothers.

## **Mating Results**

Table I shows the results of matings which had both parents' and progeny's colours listed in the Australian Alpaca Association Herd Books, Vol5 2-11 [8] inclusive. Mating white x white gave a 2% chance, and mating colour x colour (excluding grey) gave less than 2% chance of getting a grey cria. However, there were 1227 white x black matings, of which approximately 7% produced a grey cria. Most of these whites are blue-eyed whites, and the white sires in particular have multiple grey progeny. Grey x grey matings produced 2% white progeny, some of which are definitely blue-eyed whites. How many is not certain, as they can only be tracked through their own production of a grey cria from a dark mating. I have collated over 500 alpaca names from the Australian Herd Books [8], which I know or expect to be blue-eyed whites, based on their breeding results.

Of thirteen verifiable matings of bew females with coloured sires (medium fawn to black), there were 11/13 females; 10/13 greys, one of which had blue eyes; 1 piebald; 1 black tuxedo; and 1 white/very light fawn male. All of the cria appear to be normal and healthy in all respects, including hearing. All bar one have dark eyes.

## **Recommendations**

Breeders who intend to use a blue-eyed white alpaca for breeding should consider the following points:

1. Check the fertility of a new addition to the breeding herd.
2. It is undesirable, and unnecessary, to create more blue-eyed whites. Any mating which does produce a blue-eyed white cria, should not be repeated, whatever the colours of the parents. The two partners in such a mating should be re-mated to dark-eyed, solid dark mates to reduce the risk of getting another one.
3. Blue-eyed whites should not be mated to greys, or to broken coloured mates, as these matings are more likely to produce blue-eyed white progeny.
4. There is no valid justification for mating two blue-eyed whites together, as this mating is very unlikely to produce a live cria at all.

5. The best mating for any blue-eyed white alpaca is to the darkest mate available, preferably a solid black or dark bay. This mating will greatly reduce the chance of another blue-eyed white, and produce a more coloured cria. The cria can then be bred on with more colour matings. The merle and/or tuxedo genes may be more widespread than is realised, through the white and light fawn herds where they are not so obvious. They circulate around and give everyone a surprise now and then.

6. Blue-eyed whites should also be kept in a herd situation to minimise the impact of deafness on their social development.

## **Conclusion**

If merle alone is responsible for the pattern seen in most grey alpacas, then it is possible that some blue-eyed white alpacas are homozygous merles. It is also possible that some blue-eyed whites are a combination of merle plus white-marking genes such as tuxedo, or piebald; or even a combination of white-marking genes without merle.

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There were many blue-eyed whites in the original imports, and one of the most influential foundation sires in Australia is a blue-eyed white. That sire, through himself and his progeny, is responsible for hundreds of grey, and blue-eyed white alpacas in the national herd. All greys, many whites, some fawns and even a few blacks probably have the potential to produce blue-eyed white progeny in the right mating. They occur with some regularity from even the best white-breeding lines, in which case they often have very good fleece qualities, and represent a valuable fibre resource.

Finally, there is no actual 'blue-eyed deaf white' gene, nor is it a 'disease'. The condition is most likely to be caused by a combination of genes, which can be managed in the relevant breeding situation.

I believe that the best use for blue-eyed whites is the production of more, and possibly better-fleeced, grey and coloured alpacas.

## **References**

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