Pied inheritance – more complicated than we like to view it

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The article in the September-October Journal of the ANCS by Pieter Klapwijk raised questions about the inheritance of the Pied mutation in Cockatiels. Similar questions have been raised by breeders in a number of other parrot species with regards the inheritance of Recessive Pieds, particularly here in Australia where it is becoming popular for some breeders to view them as co-dominant. I write this article in response to the previous article to try to explain some of the complexity involved with the inheritance of Pied mutations and why this mutation in Cockatiels is correctly recognised as recessive.

Pieter Klapwijk's article focuses on the ratios of gene inheritance to subsequent generations and it is a fact that the ratios are always identical irrespective of the mode of inheritance. When defining the mode of inheritance, the simplest rule is to determine which phenotype is produced by the first cross of **Pied X wildtype**. If the result of this first cross is 100% wildtype, then the inheritance is recessive. If the offspring are 100% the same as the parent, then the inheritance is dominant. If the appearance is midway between the two parents (in 100% of offspring), then it reflects co-dominant inheritance.

In a true dominant Pied mutation, as exists in Budgerigars, Peachface Lovebirds and some other species, all youngsters from this first cross are unmistakably Pieds, very similar in degree of pied markings to their parents, allowing for the inevitable degree of variation seen in all Pieds. These are true dominant Pieds.

In contrast, when a Cockatiel is bred like this, the youngsters produced are no where near the Pied parents phenotype, they are instead almost wildtype, but with a few 'pied' markings. At first this may seem to indicate a co-dominant mutation, however in that situation the heterozygous (SF bird) is midway between the two parents in colour. Whereas the birds produced by Pied outcrosses have much less than 10% pied pattern, irrespective of the degree of Pied markings in their parent. That is not co-dominant inheritance.

Pieter Klapwijk raised the question whether any 'splits' ever are pure wildtype in appearance and the answer is yes. In the early days of the Pied mutation, dating back to when they first became available publicly in Australia in the late 70's /early 80's, most split birds showed no sign of pied markings. So why do so many 'splits' show these markings today?

The answer lies within the selectable variation we see in Pieds in all species of animals. Those early Pieds had on average far less pied pattern than today's birds. Why have they changed? Because breeders have been selecting for 'better' pied markings and in doing so are selecting for modifiers to 'improve' the basic Pied pattern produced. And it is these modifiers that are causing the 'break through' pied markings in many of the

splits and causing breeder's confusion about the inheritance. Exactly the same thing has been seen in all other species of birds with recessive Pied mutations.

The 'modifiers' are actually a collection of dominant minor pied genes, recessive minor pied genes and true modifiers. In total there are perhaps 10-15 different ones that can be 'collected' together to produce the enormous range of markings we see in different Pied Cockatiels. But they all rely on the one major Recessive Pied gene to give them significant expression. Without the major gene, the modifiers and recessive genes will not even make themselves apparent. The Minor pied genes, on the other hand, show themselves with small degree pied patterns, and it is these that produce the 'visible splits'. In themselves they only produce a pattern of less than 10% pied markings. These markings are always in the same regions in every species – back of the head and the extremities – wing flights, tail and feet.

Many of these minor genes are desirable and their selection important to produce a high quality pied. So what is the harm in viewing these birds as 'SF Pieds'? This problem has already been seen in Rainbow Lorikeets in Australia. Breeders who view these as dominant traits then mate the 'SF birds' across Normals to produce more 'SF birds' which they can then sell to other breeders. But since the trait is due to a separate minor Pied gene, it can be inherited independently of the important major Recessive Pied gene and before long these 'SF birds' no longer carry the major Pied gene. In Rainbow Lorikeets the 'Streaky head' gene is a dominant minor Pied gene independent to the major Recessive Pied gene. Breeders are producing 'Streaky heads' and selling them as 'SF birds' but many of these birds only ever produce more 'Streaky head', never any good Pieds in future generations because they no longer carry the major gene.

It is also important to understand the recessive nature of these genes if the hobby to prevent the loss of non Pied birds altogether. In canaries the pied gene (referred to as variegation in this species) is carried by almost 100% of individuals. And in Bengalese finches until very recently, all Australian birds carried the Pied gene. Dominant genes can be easily selected against, but if breeders try to remove the Pied gene from Cockatiel strains, then the major gene will be easily selected against but not the hidden recessive genes (both major and minor).

For many breeders it becomes a matter of semantics whether they view the Pied mutation as recessive or dominant. But if breeders lose sight that the major gene is the most important aspect, then they can quickly lose the higher quality Pied birds. Cockatiel breeders have managed to produce high quality Pieds by viewing the mutation as recessive and then using the existence of all the modifiers and minor genes to perfect the pattern produced.