



Cat Coat Color Genetics Part 2: Coat Patterns

As you will remember from our previous newsletter, we began our discussion on cat coat color genetics by focussing on the basic coat colors that are genetically determined. In this edition, we continue the discussion looking at coat patterns that are genetically determined and that can be identified by DNA testing.

AGOUTI

Many cats have hair that has alternate banding of dark and light pigmentation along the shaft. This banding (or ticking) of hair is known as Agouti, and is genetically designated "A". The gene responsible for this banding is called the "Agouti Signaling Protein" or "ASIP".

A DNA change in the ASIP gene (designated non-agouti, or "a") can significantly affect the fur pattern in cats. A cat that inherits two copies of the altered gene (or "aa") has full pigmentation along the entire hair shaft resulting in the cat being "solid" in color.

The normal banding effect by the Agouti gene is dominant in terms of inheritance, that is, the banding pattern will result if the cat carries either one (Aa) or two copies (AA) of the Agouti gene. Therefore, AA and Aa cats cannot be distinguished by look

alone. Only a DNA test can prove which cat is a carrier of non-Agouti.

In most cats, the banded agouti fur alternates with solid colored fur in a pattern called tabbying. The type of tabby pattern is controlled by another group of genes, as yet not found. These tabbying or "Tm" genes determine whether the tabby pattern is Mackerel, Classic or another tabby pattern type.

The Tabby pattern gene (Tm) is present in all cats, including solid colored cats. However, it is only when the cat has the dominant Agouti (A) gene that the Tabby pattern is seen. The only case where this is not true is in solid orange/red cats, where the "O" gene overrides the effect of the "aa" non-agouti gene, resulting in some form of tabby stripping.

Table 1 summarises the genetics of the Agouti gene and the presence of the Tabby pattern.

continued page 2

**STOP
PRESS!**

**BLOOD
GROUPING
TEST
COMING!**

Inside this issue:

CAT COAT COLOR GENETICS PART 2: COAT PATTERNS **1**

COLORPOINT (COLORPOINT RESTRICTION) **2**

DNA QUESTION CORNER **3**

NEW MEMBERS **4**

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Table 1. Agouti/Tabby

Agouti gene	Marking
AA	Tabby
Aa	Tabby
aa	Solid (except in Orange/Red)

Colorpoint (Colorpoint Restriction)

The Color gene, or sometimes known as the Himalayan gene (designated “C”) codes for the enzyme, tyrosinase which plays an important role in the production of pigment. Genetic changes in this gene, which can be detected by DNA tests, results in temperature-sensitive pigment production.

Typically when two copies of the altered gene are present in a cat, pigment production works more efficiently at the cooler extremities, like the face, tip of the tail and paws. These areas have significantly more pigment production and hence look darker than the warmer body of the cat.

Even though pigmentation occurs at the cooler points of the cat, this colour is not normally as intense as that found in a full, solid colored cat.

The gene variant responsible for the typical Siamese point pattern is designated “c^s”, while the variant responsible for the Burmese pattern is designated “c^b”.

The full color gene “C” is dominant over these variants, hence for a cat to have the pointed coat they must have two copies of the variants (ie c^s c^s or c^b c^b).

Cats found to be “c^sc^b” are known as Tonkinese. These cats have the classical “mink” color, that is the Siamese pattern, but with a darker body color.

Cats containing only one variant gene are known as a carriers, and will not have the classic points color pattern (for example C c^s).

The mating of two cats that each have two copies of the variant gene (ie c^s c^s) results in all kittens having the points pattern.

On the other hand, mating two carriers (Cc^s and Cc^s) will, by probability, result in approximately half the litter being carriers while one quarter will be pointed.

Table 2 summarises the resulting points color with respect to the basic coat color, together with the effect of the dilute gene.

continued page 3

Table 2.

Base Coat Color	Dilute Gene	Resulting Points (c ^s c ^s)
Black B- B-	D- dd	Seal Point Blue Point
Chocolate bb bb	D- dd	Chocolate Point Lilac Point
Cinnamon b'b' b'b'	D- dd	Cinnamon Point Fawn Point

DNA Question Corner—win free tests

Animal DNA Laboratory gives all readers the opportunity to ask questions relating to animal genetics. The best question each issue will win 2 free DNA tests and be published in the ADL newsletter. So if you have a question simply send it to:

dnaquestions@animalsdna.com

This quarter’s winner is Blair Duncan from Wellington who asked. ***“My top queen has had a new litter. Although I was fairly certain who the sire was, after looking at the kittens I am now wondering whether the sire was in fact, one of my other breeding males. Can I do a DNA test to find the true sire?”***

Dear Blair,

Yes. It is called a Parentage Verification test.

All cats (except identical twins) have their own unique DNA. In the laboratory we can

examine and compare a cats DNA using the much publicised, DNA fingerprinting.

This is the same technique as used by the police (and CSI) in matching evidence at a crime scene to a suspect.

A cat inherits one copy of their DNA from each parent. When testing for correct parentage, a cats DNA fingerprint is compared with that of the dam and the potential sires. Any DNA present in the offspring that is not found in the dam is concluded to have come from the true biological sire.

A panel of cat-specific genetic markers are used to produce a cats DNA fingerprint. Again, this fingerprint is unique to that cat (except for identical twins). Each marker generates two genetic measures (or alleles), one from the dam and one from the sire. In the laboratory we measure and report the size of each allele (eg 207 & 211).

continued page 4

In the near future Animal DNA Laboratory will be providing tests for blood grouping.

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DNA Question Corner—continued

When all the genetic markers from the kitten match one of the potential sires, it is then concluded that he is the true sire. The reverse is also true, that is, when a potential sire does not match the offspring at a number of markers, then by the laws of genetic inheritance, one can exclude or eliminate him as being the true biological sire.

We will be continuously adding new tests so feel free to keep up to date with our progress;

www.animalsdna.com

Animal DNA Laboratory offers a 10% discount to the members of clubs and Associations that have registered with us. Some clubs or Associations that have registered with us are:

Cat Association of Western Australia	www.coawa.optiic.com/index.htm
Colourpoint Cat Club (United Kingdom)	www.colourpointcatclub.co.uk/links.htm
Feline Control Council of Victoria	www.hotkey.net.au/~fccvic/fccv15.htm
Cat Authority of Victoria	http://cavinc.org.au/
Governing Council of the Cat Fancy SA	http://users.chariot.net.au/%7Eqccfsa/
Governing Council of the Cat Fancy Aus & Vic	http://www.cats.org.au/Links/links.html
New Zealand Cat Fancy Inc	http://nzcf.com/
The Feline Association of NSW	http://www.feline.com.au/
Australian Cat Federation	http://users.sa.chariot.net.au/%7Eacfinc/Annex/links.htm
Waratah National Cat Council	http://www.wnca.com.au/