



BY

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Everything you need to know about Genetics...

You can learn from your Cat!

PART TWO

WHY THE BLOTCHED TABBY IS A CLASSIC!

Carl Linnaeus (1707 – 1778) is known as the "father of modern taxonomy for developing the binomial nomenclature (genus species), the modern system of naming organisms. For each named organism, an archetype or voucher individual is identified and maintained in a museum. Linnaeus, himself, is the "voucher" specimen for *homo sapien*, man.

Linnaeus spent his life dedicated to the pursuit of taxonomy and in 1758, his works declared the domestic cat as, *Felis catus*; Linnaeus, 1758)¹. His description of the archetype specimen is: {*F. cauda elongata, corpore fasciis nigricantibus; dorsalibus longitudinalibus tribus; lateralibus spiralibus*}. – a blotched tabby.

Many taxonomists have worked to properly classify cats and felids, which is an ongoing process²⁻⁶. The early taxonomists considered the tabby pattern of domestic cat as dimorphic, having two pattern-phases - blotched and torquata (striped). Striped tabbies were more noted in the African wildcats (*Felis lybica*; Forster, 1780) and European wildcats (*Felis silvestris*; Schreber, 1777), but the blotched tabby was only found in domestics. Hence, the voucher specimen for the domestic cat is the "blotched" tabby – and no doubt, why blotched tabby is also called the "classic" tabby!

The term "tabby" pre-dates the formal cat taxonomy and was used in the 1630's as an adjective describing "striped silk taffeta," from French word tabis "a rich, watered silk" (originally striped), from Middle French atabis (14c.), from Arabic 'attabi, from 'Attabiyah, a neighborhood of Baghdad where such cloth was made, said to be named for prince 'Attab of the Omayyad dynasty⁷. The word "tabby" is also suggested to have a Turkish origin from the word "utabi"⁸

Contrary to the voucher specimen, the "wildtype" normal domestic cat is considered to have a striped tabby pattern, also known as a mackerel tabby (**Figure 1e**). Sometimes the stripes of the pattern are very regular and narrow, other times a bit irregular, to an extent of being considered a "broken mackerel" (**Figure 1d**). The "classic" or "blotched" tabby was firstly recognized as an autosomal recessive Mendelian trait by Whiting, 1918⁹. Cats with the blotched pattern have thick lines of swirls of their flanks that form a "bull's eye" and the dorsal stripe is also broader (**Figure 1c**), considerably different from the lacking of pattern in an Abyssinian (**Figure 1a**) or cats with only the leg barrs (**Figure 1b**). The cause for spotting patterns is yet unknown (**Figure 1f**).



1a



1b



1c



1d



1e



1f

Figure 1. The Tabby and Ticked phenotypes of the domestic cat. The images present the different phenotypes of the patterning loci in different cats.

a) The Abyssinian is absent of any markings, but each hair is banded with yellow and black pigment (ticking). This cat is likely homozygous for the allele Ti^a/Ti^a .

b) This longhaired household pet has barring on the legs but no pattern on the torso and is likely heterozygous Ti^a/ti .

c) Cats with more pattern must be wildtype at the Ticked locus, ti/ti , For the *Tabby* locus, the silver blotched (classic) American shorthair is tb/tb .

d) The household pet does not have perfect stripes thus its mackerel pattern is a bit broken and may have the genotype $ti/ti, T^M/tb$.

e) The Toyger breed is selected for strong mackerel Tabby markings and is likely $ti/ti, T^M/T^M$.

f) Yet undefined genes and alleles influence patterning and the genotype of the spotted tabby Ocicat is unknown.

(Cat images by Chanan Photography – Richard Katris).

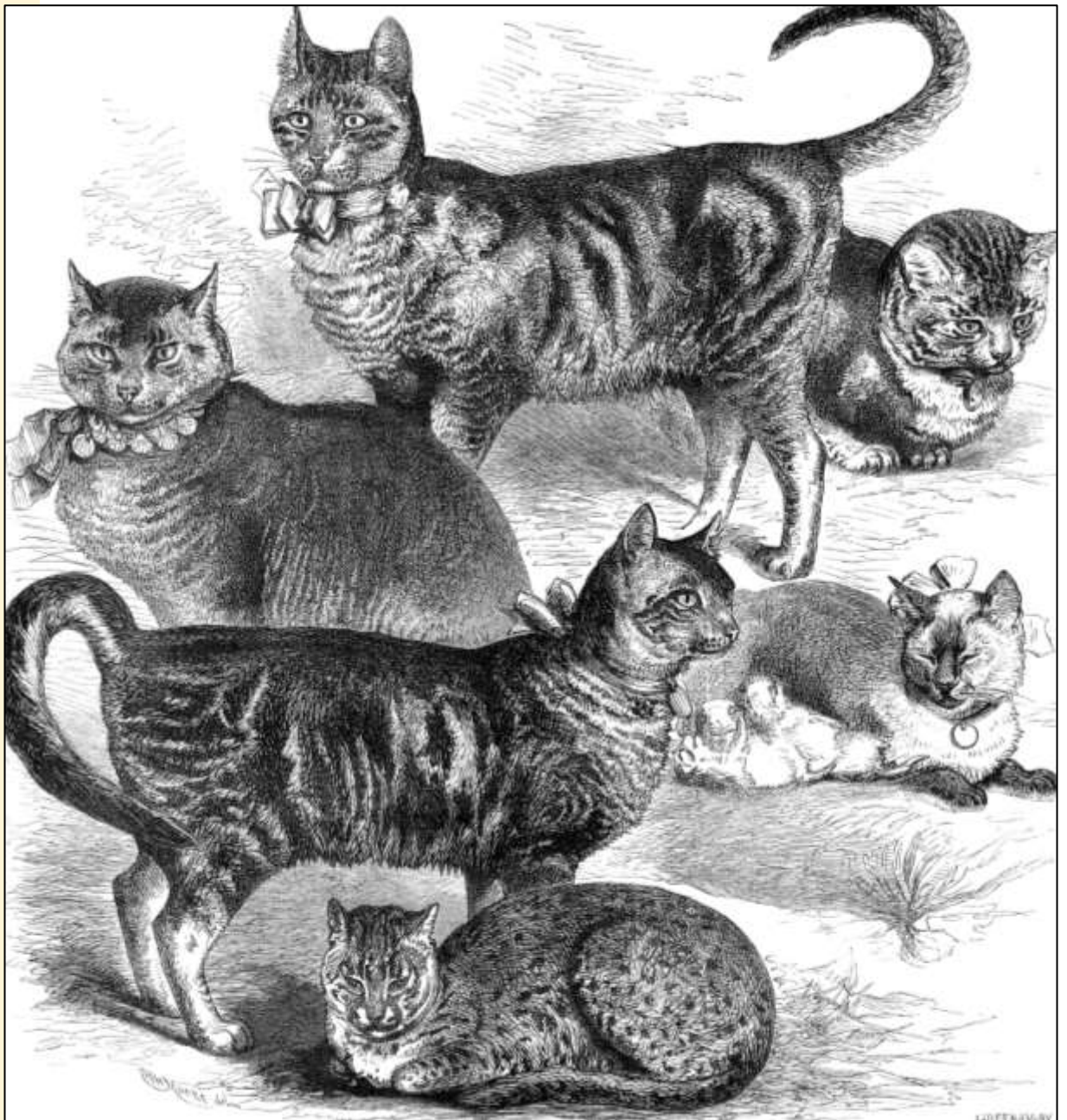
EVERYTHING YOU NEED TO KNOW ABOUT GENETICS – *YOU CAN LEARN FROM YOUR CAT!*

Many scientists performed field studies around the world counting the number of cats with recessive phenotypes, including blotched tabby¹⁰.

The allele frequencies for blotched tabbies in different countries around the world suggest the mutation arose in the United Kingdom where blotched tabbies are highly prevalent, hence, long after domestication and dispersal of cats through-out the Old World¹¹.

As the British then colonized different regions of the world (Australia, New Zealand, the New World), the blotched tabby pattern also dispersed to these countries. The pattern is less common in the Near East, the seat of cat domestication.

The classic Tabby pattern is clearly recognized at the first cat shows at the Crystal Palace and the trait was present in some of the early awarding winning cats.



Prize-winning cats at the Crystal Palace Cat Show of October 1875, showing two blotched tabbies, and at the bottom an Indian wild cat (spotted) owned by Mr. George Billett.

Patrons of this show included Lady Dorothy Nevill, and Dr Charles Darwin.

The Illustrated Sporting and Dramatic News.

Image courtesy of The Harrison Weir Collection.

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Part of the conundrum with tabby patterns is the cats who lack a pattern, or have minimal barring present on only the legs, such as the Abyssinian. Three alleles of the *Tabby* locus (T) were later suggested, namely, Abyssinian (T^a), striped (T^m), and blotched (t^b)¹².

The Abyssinian was considered incompletely dominant to the striped and blotched alleles because markings were often present on the legs of the cat. Striped was considered completely dominant to the blotched. Thus, $T^a > T^m > t^b$ – thereby forming what is called an “allelic series” for the *Tabby* locus¹².

However, when breedings of cats were conducted very scientifically, and cats can only have at most two of the three alleles, the outcomes of the crosses suggested the patterning of cats was more complicated, perhaps at least two different loci controlled the tabby patterning. Also, what about the spotted tabbies now seen in Egyptian Maus and Ocicats, how do they fall in the mix?

The initial genetic studies for the *Tabby* locus were conducted in 2006 on a closed colony family of cats from the WALTHAM Pet Nutrition Centre and indicated the locus controlling one of the tabby patterning loci was on cat chromosome B1¹³.

At the time, this locus was considered the *Tabby* locus. In 2010, additional cat colony studies indicated the locus on cat chromosome B1 actually controlled the ticked patterning, which is common to Abyssinians, and was renamed the *Ticked* locus. A second locus controlled the *Tabby* alleles T^M and t^b , and mapped to cat chromosome A1¹⁴.

One or more additional loci were thought to act as modifiers and create a spotted coat by altering mackerel stripes. Thus, the cat chromosome B1 locus, the *Ticked* locus (Ti), seems to control presence or absence of a pattern where the *Tabby* (Ta) locus helps control the type of pattern, such as mackerel or blotched tabby.

The gene at the *Tabby* locus has been identified as *LVRN* – *laeverin* (a.k.a *Aminopeptidase Q (TAQPEP)*)¹⁵. At least three different mutations are now associated with classic tabby patterns and an additional DNA variant is associated with an atypical swirl when in conjunction with one of the blotched tabby alleles.

This discovery supported the observations by J.B.S. Haldane and A.G. Searle, who suggested the blotched tabby in the USA appeared a bit differently than the cats in the United Kingdom^{16,17}. The tabby patterns have also been compared to pigments and patterns in other species^{18,19}.

The gene for *Ticked* is still to be discovered and the *Tabby* and *Ticked* loci do not explain all patterning, especially the distinctive spots of the Egyptian Mau or the Ocicat. Cats with the Ti^a/Ti^a have nearly no patterning, while Ti^a/ti cats may have some barring.

If a cat is ti/ti at the *Ticked* locus, then pattern expression at the *Tabby* locus can be seen, which will be T^m/T^m (mackerel) or T^m/t^b (mackerel or broken mackerels) or t^b/t^b (blotched).

In addition, the swirls and spots of Bengal cats are likely under the influence of additional genes and the leopard cat specific DNA alleles. But now we know how and why a blotched tabby is a classic!

EDITOR:

This is the second

in a series

of articles

based on

feline genetics

by Dr Leslie Lyons

that will be

published in

FELIS HISTORICA

in the ensuing months

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