

# Polydactyl Maine Coons

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Mainelymagic Maine Coons

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### Polydactyly in the Maine Coon cat

It is accepted that a good percentage of the breed were polydactyls originally. The definitive book of the Maine Coon "That Yankee Cat" by Marilis Hornidge discusses the standard;

"The paws are large and round with their prominent tufts. The number of claws in those paws was perhaps the most controversial of all issues in the final stages of setting up a standard. The traditional MC was frequently a polydactyl or many-toed cat, a genetic mutation that occurs with great frequency in the upper north-eastern United States...Whatever the reason for its abundance in this geographic area, the "poly" or snowshoe-footed cat is part of the Maine Coon legend.

Polydactylism was so dear to the hearts of the original group of enthusiasts who drew up the MCBFA standard, that rather than divide the ranks, a special classification with its own standard was set up for cats possessing the trait."



Some authors estimate the percentage of polydactyls in the breed to be originally as high as 40%. In an interview in 1976 (not long after the Maine Coon was first accepted for showing) one of the foremost experts in the breed Beth Hicks stated:

"I don't know if you are familiar with it but there was a study done by someone connected with a university in the 1950's which showed that 40% of the Maines were polydactyls. Now, this was before they came back on the show circuit."

Sadly, it appears that this trait is being bred out of the Maine Coon simply to fit in with the dictates of the show world.

Polydactylism was not seen in other breeds when the Maine Coon was first accepted as a breed and all other breed show standards listed 5 toes in front and 4 behind. When the Maine Coon Breeders and Fanciers Association (MCBFA) were putting together a show standard there was a lot of debate surrounding the issue of polydactylism. There was some resistance to the acceptance of the Maine Coon—"it's only a barn cat after all" - and many felt that insisting on allowing the standard to reflect the polydactyl variation could be the death knell for its acceptance into the show hall. It was always the intention of that early group of dedicated fanciers that once the ordinary Maine Coon was accepted, they would then put forward the polydactyl standard. Early correspondence and literature dating back to 1969, shows that polydactyl cats were always intended to be accepted for showing and they were never viewed as deformed or detrimental.

The official publication of the MCBFA the "Scratch Sheet" of 1970 clearly shows that there was (and still is) a Maine Coon Polydactyl Standard voted in by the membership as follows:

"Our MCBFA Polydactyl Standard has been voted in by our membership, and the wording is as follows. The Maine Coon Polydactyl Cat should conform to the Standard of the Maine Coon Cat, with the exception that multiple toes are allowed on either fore or hind paws or both."(Ref 7)

The Maine Coon Polydactyl Standard remains in effect today - it has never been removed. The Cat FAQ on the MCFBA web site refers to the trait: "However, modern purebred Maine Coons are rarely polydactyls. This is because all cat associations automatically disqualify polydactyls from competition in the purebred classes. Because of this, most polydactyls were culled from the Maine Coon breed decades ago and only a few breeders continue to work with them."(Ref 8)

This goes some way in establishing that the attempted eradication of the polydactyl was simply motivated by show issues and not for any health reason.

The statement above that "all cat associations automatically disqualify polydactyls from competition in the purebred classes" is no longer correct as the New Zealand Cat Fancy has accepted polydactylism in the Maine Coon by altering the standard to allow for extra toes.

Article 4b of the MCBFA constitution clearly states that an object of the society is "...protecting the Maine Coon Cat from obliteration of any of its naturally evolved features." But unfortunately the fanciers now at the helm are many years distant from those original devotees and have moved away from the polydactyl trait and preserving the breed's heritage.

Those original breeders who instigated the acceptance of the Maine Coon clearly intended the polydactyl standard to be implemented as soon as the breed cemented its championship status. In a letter of 29th September 1973, the then President of the MCBFA Mr Ljostad says

"We have a six toed kitten in our house too. You are right that they are not accepted at cat shows yet. We knew that many Maine Coons were polydactyl and did not want this trait to get entirely lost from the breed...."(Ref 9)

The word "yet" at the end of the second sentence clearly indicates that this trait was intended to be recognised in the future.



*Mainelymagic Digitally Enhanced (top) along with Mainelymagic The Jazzman P were the first polydactyls in the world to gain the title of Champion.*

Sarah Hartwell observes;

Polydactyl cats are said to be virtually non-existent in Europe, because "unusual looking cats" were destroyed due to witchcraft superstitions, practically eliminating the trait (Kelly, Larson, 1993). I do not know whether Britain was included in the generic term "Europe" or whether it meant mainland (continental) Europe only. In Norway, polydactyl cats are known as "ship's cats" as the extra toes supposedly gave them better balance on ships in stormy weather; they are not uncommon and polydactyl kittens are sought after pets. Polydactyl random-bred cats have been reported in Sweden though other European cat lovers (locations not reported) had apparently never seen a polydactyl. They are common enough in Britain to be considered unremarkable.

Polydactyl cats were considered "lucky" by sailors. Sailors also believed polydactyl cats to be superior mousers and ratters. Employed as ships' ratters and lucky mascots, they would have reached America with early British settlers hence their greater frequency in Eastern states. A disproportionately high number of "lucky" polydactyl cats, compared to normal-toed cats, would have found their way there. This would lead to a greater proportion of polydactyls than usual for a random-breeding cat population. (Ref 2)

The incidence in the breed today is unknown but is very much reduced from the original estimated 40%. This is because most mainstream breeders, who enjoy showing, do not breed polydactyls as they cannot be shown.

In her 2004 article in the "Maine Attraction", Lucinda King writes;

"Recent discussions show that many UK breeders oppose the polydactyl, yet research by the writer shows that many of these breeders have polydactyls in the first 5 generations of their pedigrees. Indeed some of the top show cats in the UK come from polydactyl lineage. One argument for this is that a poly to non-poly mating will derive a litter where 40 to 50% of the resultant litter will be polys, but all of the litter usually have increased boning. Hence perhaps thereby producing the size often required to do well in show in the non-poly.

A crude analysis of members web sites of the two GCCF affiliated Maine Coon Clubs in the UK show that of those with pedigrees or pedigree names on their web sites that can be traced, 63% of these breeder members have polydactyls within the first 5 generations of at least one of their Dams pedigrees. This figure is lower for Sires with 37% having polys within the first 5 generations of at least one of their Sires. However, it must be remembered that a Sire will produce many more progeny than that of a Dam."(Ref 10)

## What is Polydactyly?

In humans, polydactyly is considered a common occurrence.

Dr Alan Greene (MD FAAP) author, pediatrician, lecturer and keynote speaker says;

"Polydactylism, or having one or more extra fingers or toes, is probably the most common abnormality of development found at birth. Polydactylism is reported in about 2 per 1000 children. However, many of the simpler cases are taken care of in the nursery by the obstetrician or pediatrician and don't show up in these statistics." (Ref 1)

Anne Boleyn, Winston Churchill and King Charles VIII of France (ref World Knowledge Library) are some famous polydactyls.

"Polydactyly is an ancient trait and but for a quirk of evolution, all modern animals would have 7 or 8 digits instead of just 5. The oldest known four-legged animals, Ichthyostega and Acanthostega, had 7 or 8 digits per limb. The "extra" digits were next to the thumb. The extra digits disappeared 350 million years ago, leaving modern animals with just 5 per limb. 100 million years after evolution opted for five digits, throwbacks to ancestral polydactyly occurred, as a fossil of a seven-toed reptile demonstrates. The fossil, an aquatic marine reptile called Nanchangosaurus, was an mutant or evolutionary throwback which lived 100 million years after other seven-toed amphibians had died out." (Ref 2)

There has been concern in the Cat Fancies that polydactyly may be associated with other abnormalities that we would not want to encourage in cat breeding. It is important that we separate true polydactyl from other syndromes that happen to include extra digits such as Ellis-van Creveld syndrome which is a disorder of the skeletal dysplasia type and includes cardiac malformation, dwarfism, cleft palate as well as extra digits. This is an autosomal recessive gene found on the chromosome 4 short arm and quite distinct to the simple dominant polydactyl gene found in the Maine Coon cat.

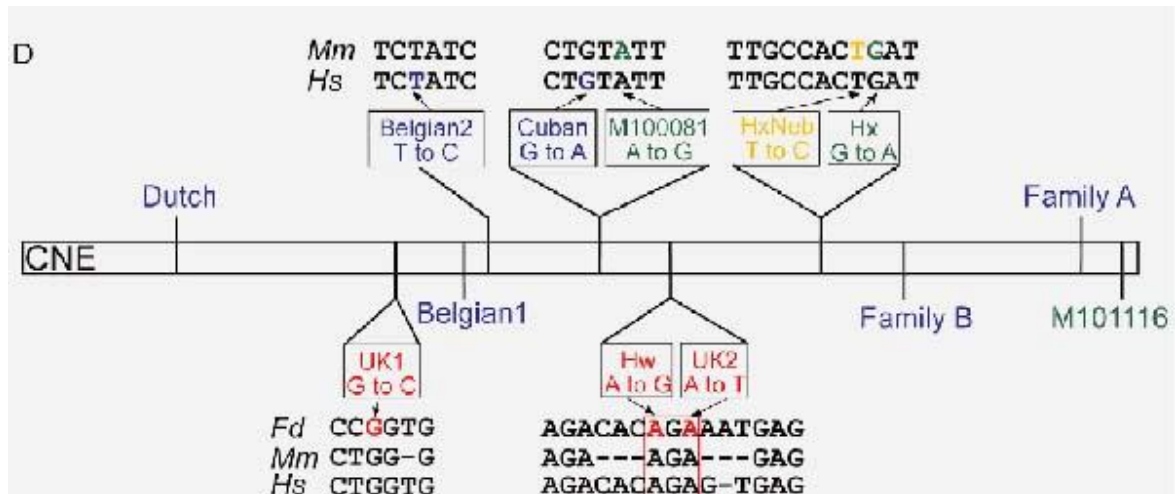


## Genetics

The polydactyl gene in the Maine Coon breed is the standard benign autosomal dominant gene for polydactyly, Pd. This gene has been identified following the sequencing of the cat genome.

Preaxial polydactyly is caused by ectopic expression of the signalling molecule Sonic Hedgehog (SHH) in the developing limb bud. Mutations in the long-distant, limb-specific cis-regulator for SHH, called the ZRS, are responsible for the ectopic expression which underlies the abnormality. Populations of domestic cats which manifest extra digits, (including Maine Coons and the celebrated polydactylous Hemingway's cats), also contain mutations within the ZRS. The polydactylous cats add significantly to the number of mutations previously reported in mouse and human and to date, all are single nucleotide substitutions.

The variant of the Pd gene found in Maine Coons and other North American cats has been called Hw and is slightly different to the Pd genes found in cats from Great Britain (UK1 and UK2). (Ref 3)



The Pd gene is harmless even when homozygous and is not known to be associated with other anomalies. It has complete penetrance.

Sarah Hartwell describes it thus; *The form of polydactyly most commonly seen in cats is a simple autosomal (i.e. not linked to gender) dominant trait which does not affect the cat adversely and is not associated with other abnormalities.*(ref 2)

Polydactyl is easy to select for or against when breeding Maine Coons. You must have a polydactyl to breed a polydactyl. If you do not have a polydactyl you cannot have one born in a litter.

There are 2 forms of polydactyly; pre-axial and post-axial. Axial refers to the folding of the embryonic limb. The "thumb" side is before the axis (pre-axial) and the "little finger" side is post-axial. In humans it is usually post-axial i.e. an extra little finger, whereas in cats it is normally pre-axial with the extra toe on the thumb side of the foot.

The Pd gene in Maine Coons has a variable expression and can give rise to a varying number of toes with a natural maximum number of 7 toes on each foot. There are different phenotypes associated with the gene. The most common are "mitten paws" and "hamburger paws".

Photos on the right show:

Top: a mitten paw

Bottom: a hamburger paw



In one of the first scientific articles on polydactyly in cats (1949), Charles Danforth (Dept of Anatomy, Stanford University School of Medicine) says: *"Although the domestic cat normally has eighteen digits, five on each front foot and four on each hind foot, the occurrence of individuals with more than that number is not uncommon."* (Ref 4)

Earlier studies on guinea pigs had found one form of polydactyly that is lethal when homozygous.

Dr Danforth raised polydactyl cats in his laboratory and reported on 234 normal and polydactyl kittens in 55 litters. His matings reflected a simple dominant trait and he concluded that there was no evidence that the homozygous form was naturally lethal;  
*the data ... (is) sufficient to show that the type of polydactyly studied behaves as a simple dominant with good penetrance, but variable expression and to indicate that there is no reason to suspect the gene of being lethal when homozygous.* (Ref 4)

For some reason it seems that in Germany, officials are of the view that the Pd gene in cats is in fact lethal when homozygous and they reference the Danforth article for evidence of this conclusion. We can only surmise that an error in translation many years ago led them to this erroneous conclusion.

More recently, Dr Solveig Pflueger's article in the Cat Fanciers Journal 1998 expanded our genetic knowledge of polydactyly. In this article she states; "it does not appear to affect the cat adversely and is not known to be associated with other anomalies"(Ref 5)

### Radial Hypoplasia

There has been much scare mongering about the ethics of breeding polydactyl cats caused by the emergence of the "Twisty Cats" in 1998.

Dr Pflueger (MD, PhD, FACMG) is considered one of the world's leading geneticists. Her 1998 article discussed the usual polydactyl gene (Pd) and the Twisty Cat gene (Tw). After reading her article I had a personal conversation with Dr Pflueger and we discussed the Pd gene and the Twisty Cat gene. Dr Pflueger stated categorically that these 2 genes were quite different genes, that the Tw gene has never been seen in the Maine Coon Cat and never would be unless someone introduces an outcross cat that carries the gene. (Ref 6)

The Tw gene is also a dominant gene with variable expression that gives rise to triphalangeal pollex-radial hypoplasia. An unknown polydactyl cat may in fact have this gene as in its mildest expression it can appear to be normal except for extra digits. However if used for breeding this polydactyl of unknown origin will produce 50% of its offspring with the Tw gene. Some of those will have severe radial hypoplasia (RH). Dr Plueger told me that if a polydactyl cat has been bred from with no incidence of radial hypoplasia then that cat has the usual benign Pd gene and not the Tw gene. (Ref 6)

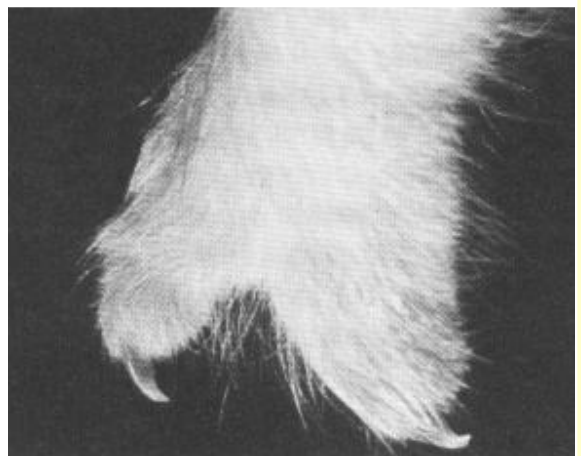
As the polydactyl gene in Maine Coons has been bred for many generations and can be traced back to foundation stock, it is evident that this gene is not in the Maine Coon. Care must however be taken when introducing new foundation (as is allowed in the breed in the USA) to check that any new polydactyl does not have the Tw gene.

### Syndactyly

Another problem falsely associated with polydactyly is the split foot.

Syndactyly (hypodactyly) or split-foot is the opposite of polydactyly. Instead of having additional toes, the cat's forefeet (rarely the hind feet) have two toes giving it the appearance of a crab or lobster claw. In humans, the condition is sometimes known as "lobster-hand". The other digits have either been suppressed altogether or each of the cat's toes is made up of two or more fused digits. A paper by A G Searle (in "Annals of Eugenics" Vol. 17, Part 4, pp. 279-283, 1953) discussed the lobster-claw condition in cats; Searle noted that the anomaly was usually inherited as a dominant, and had suggested that the right side was often more severely affected than the left.

Syndactyly is rarer than polydactyly and is caused by the SP gene.



## The Effects of Polydactyly

There are no documented ill effects of the polydactyl gene in the Maine Coon. It is a totally benign and harmless gene with the single effect of producing extra toes on the paws. In my experience, sometimes this is confined to the front paws and sometimes the cats have all four feet with extra toes. There has not, to my knowledge, been any polydactyl Maine Coons that are unsymmetric. Both front feet are effected, not one and both back feet are affected. Maine Coons with the mitten paw configuration can produce kittens with the hamburger paw configuration and vice versa.

As discussed by Wright and Walters (1980) polydactylism "does not seem to do the animal any harm...the same cannot be said for a number of other feline abnormalities caused genetically". This is backed up by Dr Montgomery (Bone and Joint Specialist, Auburn College of Veterinary Medicine) who states "Polydactylism is a fairly common anomaly in cats that is not detrimental to their orthopaedic soundness". It is not sex-linked and it has complete penetrance.

In their 2007 paper "Point mutations in a distant sonic-hedgehog cis-regulator generate a variable regulatory output responsible for pre-axial polydactyly", Lettice, Hill et al write: "Since these mutations produce a limb-specific phenotype in human with no other discernible physiological defects, we submit that this type of polydactyly has no further detrimental affect on the cat's health." (Ref 3)

Well known NZ Feline Veterinarian and columnist, Dr Mary Austin says she has never come across any increased risk of infection in a polydactyl paw.

"In the Maine Coon polydactyls I have seen (those bred by the author from a single line) they appear to have widespread toes with very good flexibility between the digits, which leads to good air flow and therefore with normal feline care there should be no problems".

In addition to those pedigreed Maine Coon polydactyls, Dr Austin has a number of domestic polydactyls in her practice that she has treated for many years. She estimates the number of these domestic polydactyls to be 30-40 individuals. She has not seen any problems in these cats over the time they have been clients at her clinic.



*The authors polydactyl stud Mainelymagic Digitally Enhanced using his extra toes to type his emails*



*Mitten paw configuration - Digitally Enhanced.*

In the population of Maine Coons that the author has experience with, the extra "thumb" or pre-axial digit is structured as a normal toe with a retractible claw and is fully jointed. This is stropped on a scratching post in the same manner as the usual toes. Occasionally the polydactyl can also have a normal dew claw, and, as for the normal toed cat, this dew claw must be kept regularly clipped to ensure it does not grow inwards.

Owners of polydactyls should be instructed to check their cats claws and clip if necessary, as with owners of ordinary footed cats.

S Hartwell states;

"Many cat registries happily recognise breeds defined by mutations which can have lethal or crippling effects such as spina bifida in the Manx, but refuse to permit polydactyl cats as either breeds or breed variants.

The blunt statement is that polydactyly is a fault and cats with such defects are not allowed to be shown. This is a totally inconsistent approach since taillessness is also a fault, yet the Manx breed is perpetuated and shown. There are far fewer detrimental side-effects associated with polydactyly than there are with the Manx. The usual argument in these cases is that the Manx is a historical breed even though the polydactyly trait is equally historical. .... It has to be noted that cat fancies are consistently inconsistent in their approach in such matters!"

## References and Links

### References

References:

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3. Lettice, Hill, Devenney & Hill. "Point mutations in a distant sonic-hedgehog cis-regulator generate a variable regulatory output responsible for pre-axial polydactyly" Human Molecular Genetics, 2008, V17
4. Danforth C H. "Heredity of Polydactyly in the Cat", Journal of Heredity,
5. Pflueger, Solveig. "Polydactyly and Related Traits" Cat Fanciers' Journal Fall 1998
6. Conversation between S Pflueger and S Grindell, 25 May 2005
7. Scratch Sheet approx Spring 1970. The official publication of the MCBFA. Click [here](#) for copy of the Scratch Sheet.
8. Interview transcript: <http://www.pawpeds.com/MCO/mchs/articles/DonShaw3.html>
9. Private letter Sept 29, 1973 to Mrs Gould from Rodney A Ljostad President, MCBFA. Click [here](#) for copy of the letter from MCBFA archives
10. King, Lucinda. "So What Happened to the Maine Coon Polydactyls?" Maine Attraction, 2004

### Links

[Mainelymagic Maine Coons](#) The author's website for Maine Coon and polydactyl Maine Coons

[Polytrak](#) a great site with lots of information, articles and a database of cats

[Pawpeds](#) an article about polydactyly