



# THE WINN FELINE FOUNDATION

For the Health and Well-Being of All Cats

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## Genetic Mapping of Phenotypic Traits in the Domestic Cat

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*Grant 04-013*

Domestic cats worldwide are known to manifest in various forms at least twenty-three well-characterized, single-gene phenotypic traits. Affecting coat color, color distribution, the marking patterns on the coat, ear conformation, tail conformation, and fur type, including length, these traits are interesting to cat fanciers for obvious reasons. In addition, the identification of these traits also has implications for human and feline health. White spotting is associated with deafness; agouti has been associated with obesity and diabetes in other species. The human genome project has suggested that genes have several biological functions. Several traits in the cat are similarly found in other species, while other traits have similar phenotypes in other species. The possibility of a single gene or variety of genes thought to be responsible for these traits can be investigated in order to refine the list of likely candidates. The unique phenotypes of cats, such as tabby, orange, and ear fold, require a full genome scan; there is no known likely candidate.

There were three specific aims for this project:

- 1) To perform a linkage analysis with genetic markers to identify the genes causing tabby, dilution, and white spotting: Using the feline nutrition colonies at UC Davis and Waltham, 100 microsatellite markers were tested in all cats and correlations were made with dilution, white spotting, and the tabby phenotypes via a linkage analysis. No single gene was a strong candidate for these phenotypes. Linkage has been identified for two of the genes, tabby and white spotting. Of five areas that are candidates for dilution, three have been eliminated. Work is ongoing to refine the search further. The white spotting findings have been published, and the tabby association was submitted for publication in December 2005.
- 2) To investigate three genes that are strong candidates for phenotypic traits in the cat: Of the three strong candidates for phenotypic traits in cats, tyrosine-related protein (TYRP1) has been associated with brown color in other species, while fibroblast growth factor receptor 3 (FGFR3) is associated with dwarfism in humans. This study affirmed the brown mutations, chocolate and cinnamon, in TYRP1 in cats. The work has been published and service laboratories are developing DNA-based carrier testing for cats. The FGFR3 gene in cats was scanned for the same mutations causing dwarfism in humans, but these mutations are not present in dwarf cats. Either a different mutation in the same gene or a different gene altogether is responsible for dwarfism in cats. The genes Agouti and MC1R were examined and excluded from causing silver and golden phenotypes in the cat.

- 3) To identify and develop pedigrees segregating for additional phenotypic traits that naturally segregate in cat breeds: The realization of this aim is ongoing, and the investigator will interact with cat breeders. Some traits have no candidate genes. Autosomal dominant traits will be the most efficient, such as Manx, ear fold, and inhibitor. A candidate gene for long hair has become available, and both long hair and hairlessness can now be obtained, because they are segregating within some breeds. Polydactyl Maine Coon breeders have been very supportive of developing pedigrees.

This study has assisted in the identification of the mutations that cause chocolate and cinnamon, brown variants in the cat. Testing with non-invasive buccal swabs, breeders may now realize more efficient breeding programs by producing only those kittens needed to further their breeding aims. This funding also led to the identification of the genetic regions for tabby and white spotting. Winn support for this study has also assisted the researchers in obtaining an additional funding award from the Human Growth Foundation to analyze the dwarfism genes in the cat.

### **Definitions**

Genotype:

- 1) the genetic makeup, as distinguished from the physical appearance, of an animal
- 2) the combination of alleles located on the chromosomes that determine a specific characteristic or trait

Phenotype:

- 1) the physical characteristics of an animal, as determined by both genetic makeup and environmental influences
- 2) the expression of a specific trait, such as coat color, based on genetic and environmental influences

### **For more information**

Lyons, L., D. Imes, et al. (2005). Tyrosinase mutations associated with Siamese and Burmese patterns in the domestic cat (*Felis catus*). *Anim Genet* 36: 119-126.

Prepared by: Betty White, 2006