Physical anthropology - a feline paternity suit

Science, Anthropology

Insert here] [Insert here] of the A Feline Paternity Suit Your favorite cat has just given birth to three kittens. Which of your neighbor’s cats is the father? Use the provided phenotypic information, your knowledge of genetics, Mendelian inheritance, and your power of deduction to complete the following steps. The end result will be a description of the culprit.

1. Determine all possible genotypes of the kittens based on their phenotypes:

Kitten #1 is an all black cat.

trait

phenotype

All possible genotypes

hair length

short

GG, Gg and gg.

tail length

long

LL, Ll and ll

pigmentation

wild type

Pp PP and pp

ticking

non-agouti

NN, Nn and nn

coat pattern

mackerel

MM, Mm and mm

stripe color

black

BB, Bb and bb

color density

dense

DD Dd and dd

other coat colors

not white

ww WW Ww

Worked analysis

From the information given it is not certain to know which traits are dominant and which are recessive. For the hair length, let’s assume the phenotype for short tail is caused by a dominant trait G and that recessive gene causing long tail is g. Then if the kitten #1 has GG or Gg then it will have short tail but when gg then it will have long tail. Therefore possible genotypes are GG, Gg and gg.

The same case is with tail length based on the above analysis, L is for long tail and l is for short tail. L being dominant gene, possible genotypes are; LL, Ll and ll

For pigmentation, if one of the parents has P which is a dominant gene for pigmentation then when crossed with the other recessive gene p. The possible genotype for the Kitten is Pp PP and pp

Let’s say the mother had a recessive gene n for non-agouti and the father had dominant N for agouti. Then the kitten must have either nn for non-

agouti, Nn for agouti and also NN for agouti.

For Mackerel, assuming the father has a dominant gene M and father recessive m then we shall have MM mm and Mn.

The gene that determine stripe color black is determined by the mother who has a dominant gene for that. But the father having recessive gene will result in BB, Bb and bb.

The same process will be applicable when determining color density and other coat colors for the kitten.

Kitten #2 is almost exactly like its mother.

trait

phenotype

All possible genotypes

hair length

short

GG, Gg and gg.

tail length

long

LL, Ll and ll

pigmentation

wild type

Pp PP and pp

ticking

agouti

NN, Nn and nn

coat pattern

mackerel

MM, Mm and mm

stripe color

brown

BB, Bb and bb

color density

dense

DD, Dd and dd

other coat colors

not white

Ww, WW Ww

Worked analysis

From the information provided, Kitten #2 is almost exactly like its mother meaning that in almost every aspect, the mother's gene was dominant over the neighbors' cat. It therefore means that the illustrated traits and phenotypes is exactly as that of the mother.

For hair length, we shall have GG, Gg and gg. Whereby for GG and Gg will be traits representing short hair length inherited from the mother.

For tail length, if Kitten# was to give birth then there is a high possibility that two of its kitten will have long tail because of the dominant genes from the mother.

Just like the case of tail length, the Kitten will have three genotypes PP for wild type, Pp for wild type and pp representing the gene of the father.

For ticking, the kitten will give birth to two kids having agouti and the other one non-agouti since it has two dominant genes inherited from the mother

who is also agouti. Therefore the ratio will be 2: 1.

The coat pattern of this kitten as a trait produces phenotype of mackerel meaning that the mother was also mackerel. The genotype will be MM, Mm and mm with MM, and Mm being kittens with mackerel.

And for color density and other coat color, it will work the same way as the case of coat pattern due to the gene of the mother.

Kitten #3 is an all white cat.

trait

phenotype

All possible genotypes

hair length

short

GG, Gg and gg.

tail length

Short

LL, Ll and ll

pigmentation

not wild

Pp PP and pp

ticking

non-agouti

NN, Nn and nn

coat pattern

mackerel

MM, Mm and mm

stripe color

black

BB, Bb and bb

color density

dilute

DD, Dd and dd

other coat colors

white

Ww, WW andWw

Worked analysis

Looking at the phenotypes of the Kitten#3 there is high chance that the gene of the father and mother was at balance in almost every aspect, especially when comparing it with Kitten#2 which resemble the mother but has different phenotypes as that of Kitten#3.

To begin with length of the tail, the gene of the mother was dominant as it resembles Kitten#2.

For tail length, it will be in the order of LL, Ll and ll whereby gene L represent short tail while l long tail.

The pigmentation represents the gene of the father who is not wild.

Therefore the gene for wild will be l and not wild will be L.

In the case of agouti, the Kitten does not resemble the mother therefore the trait resulting into this phenotype was from the father. In this case, the gene for non-agouti is N and that for agouti is n.

When considering the mackerel, the kitten takes the trait of the mother.

On stripe color, Kitten #3 takes a different dimension from that of the

mother with gene causing black color being dominant over the one causing the brown color (the color of the mother)

Therefore the gene for black color will be B and that for brown color will be b. thus giving rise to BB Bb and bb.

For color density, the Kitten must have taken the trait of the father because we already know that the mother has dense color. Therefore in this case, let the gene for dilute color be D and d for dilute color.

For other coat colors, the Kitten assumed the father's trait who has no white color. This translates that the gene for white color was dominant and it can be W and that of non white be w.

2. Answer these questions taking into account the mother's genetic information. This may mean some of the possible genotypes you listed for the kittens may not be possible.

The mother's genetic information is:

trait

phenotype

genotypes

hair length

long

l l

tail length

long

m m

pigmentation

wild type

i i

ticking

agouti

A a

coat pattern

mackerel

T t

stripe color

black

B b

color density

dense

D d

other coat colors

not white

w w

2a. Why is kitten #1 an all black cat?

This was so because the gene of the mother causing all black color (B) was dominant over the gene of the father (b) which was not black. Therefore when crossed, the cat will be an all black one.

2b. How does kitten # 2 differ from its mother?

The kitten is different from the mother based on the stripe color. The genetic information provided above shows that the mother has a stripe color of black which contradicts with information regarding Kitten#2 who we were told resemble the mother but still has brown stripes.

2c. Why is kitten #3 an all white cat?

Since the mother is an all black cat, it therefore means that during crossing over, the gene of the mother was recessive over that of the father and could not result in all black cat. It therefore stands that father’s gene for all white cat was dominant. Alternatively, there could be a possibility of co-dominant allele which will alter phenotype when they exist in heterozygous state.

3. Determine all possible genotypes for the potential father. Use Punnett Squares to accomplish this.

trait

All possible genotypes

hair length

G G

tail length

L L

pigmentation

P P

ticking

n n

coat pattern

m m

stripe color

b b

color density

d d

other coat colors

W W

Using Punnet Squares

Let’s refer to the genotypes of the father resulting in hair length as X as dominant gene and x as recessive and that of the mother being y. Since we had found possible genotypes of the Kitten, using Punnet Squares, we can calculate a reverse role probability to find the genotypes of the potential father. For instance,

Xx

yXyyx

Xyyx

y

Since we know the genotypes of the Kittens with short or long hair, we can replace the Xy and yx symbols to get the genotypes of both the mother and the father. Since all possible genotypes for the Kittens having either short hair or long hair were GG, Gg and gg, it remains that XX will be GG, Gg being Xy and gg is xy. Thus the possible gene of the father is g and g.

The above process can be repeated to get the genes of the father as shown in the table above.

4. What is the phenotypic description of the father?

Wider context of phenotype concur with John, Nancy and Erik’s assertion that it is the traits that can be observed from an organism (John et al. pp. 69-76). These characteristics include but not limited to weight, hair color and even length of the hand.

Therefore from the above data, the phenotypic descriptions would be:

Non-agouti

Dilute color density

Mackerel coat pattern

Brown strip color

Not wild pigmentation

Short tail length

Work Cited

John P. Rice, Nancy L. Saccone, Erik Rasmussen. Advances in Genetics: Genome-Wide

Association Studies. Volume 42, (2001): pp. 69-76. Print.