

Himalayan Mountain Dog Club International and Wisdom Panel Nepal Project DNA Testing Results Summary

THE RESULTS

Number of Dogs Sampled: 14

Regions Represented: Baglung, Western Nepal; Sindupalchowk, Central (north) Nepal; Dolkha, Central (north) Nepal; Solukhumbu, Eastern Nepal; Pachthar, Eastern border Nepal; Teplejung, Eastern border Nepal; Runkum, Mid-western Nepal; Lamjung, Western Nepal; Rasuwa, Central (north) Nepal; Dolpa, Mid-western Nepal.

| HETEROZYGOSITY (GENETIC DIVERSITY)* | NUMBER OF DOGS |
|---|----------------|
| High typical range of diversity 37 to 40% for purebred dogs | 9 |
| Over typical range for purebred dogs | 3 |
| Other 29 to 35% for purebred dogs | 2 |

*The typical range for purebred dogs is 26 to 40% per Wisdom Panel. The higher the percentage the greater the diversity.

| HEALTH | |
|--|----|
| Number of Dogs Testing "Clear" for all testable genetic health issues | 14 |
| Number Testing "Inconclusive" For Progressive Retinal Atrophy (Shetland Sheepdogs) | 12 |
| Number testing "Inconclusive" For Muscular Dystrophy (Landseer) | 1 |
| Number testing "Inconclusive" Goniodysgenesis and Glaucoma (Border Collie) | 1 |

| COLOR/MARKINGS | NUMBER OF DOGS EXPRESSING (Phenotype) | *NUMBER OF DOGS CARRYING (Genotype) | NOTES |
|---------------------------|---------------------------------------|-------------------------------------|--|
| Agouti Wild Type | 0 | 1 | This is not testable ¹ |
| Chocolate v 2 (bs) | 0 | 2 | |
| Chocolate v1 (bc) | 0 | 1 | Same dog with Chocolate(bd) |
| Chocolate v3 (bd) | 0 | 1 | Same dog with Chocolate(bc) |
| Dilution (d1) | 0 | 2 | |
| Dilution (d2) | 0 | 1 | |
| Dilution (d3) | 1 | 0 | |
| Dominant Black | 2 | NA | Dominant trait -not carried ³ |
| Fawn (Sable) | 1 | 0 | |
| Mask (E ^m) | 2 | NA | Dominant trait -not carried |
| Piebald (S ^p) | 0 | 3 | |

| | | | |
|---------------------------------------|----|---|-------------------------------|
| Recessive Black (a) | 0 | 2 | |
| Recessive Red variant 1 (e) | 1 | 2 | |
| Red Intensity (i) | 2 | 1 | Tan areas are white to yellow |
| Saddle Tan (RALY) ² 1 copy | NA | 4 | |
| Saddle Tan (RALY) ² 2 copy | 1 | 6 | |
| Tan Points (at) | 9 | 5 | |

*These numbers do not include the dogs that are expressing the trait.

¹Agouti wild type (aw) is not testable. When there is only one allele on the A locus, it is assumed the other copy is Agouti wild type (aw).

²Dominant black can only be carried by a dog that has 2 copies of recessive red. Recessive red although a recessive gene, dominants all other colors when there are 2 copies.

³Saddle tan as expressed in German Shepherds does not appear to consistently express the same way in the Himalayan Mountain Dog (HMD) in Nepal. One dog appears to be expressing saddle tan or creeping tan.

| TRAIT AND ALLELE COPIES | NUMBER OF DOGS | NOTES |
|---|----------------|-------------------------------------|
| Floppy Ears 0 COPIES | 0 | |
| Floppy Ears 1 COPIES ¹ | 8 | |
| Floppy Ears 2 COPIES | 6 | |
| High Altitude EPASI 0 COPIES | 2 | |
| High Altitude EPASI 1 COPIES | 3 | |
| High Altitude EPASI 2 COPIES | 9 | |
| Long Hair Variant 1 | 8 | There are 5 variants for long hair. |
| Furnishings (Bearded) | 1 | |
| Rear Dew Claws Eastern Variant 1 copy | 0 | |
| Rear Dew Claws Eastern Variant 2 copies | 1 | |
| Rear Dew Claws Western Variant 1 copy | 6 | |
| Rear Dew Claws Western Variant 2 copies | 0 | |
| Shedding - Low | 3 | |
| Shedding- No Reduced Shedding | 2 | |
| Shedding - Occasional | 1 | |
| Shedding- Seasonal ² | 8 | |

¹Dogs with just one copy of floppy ears expressed floppy ears.

²Seasonal Shedding is described by Wisdom Panel as shedding twice per year.

COMMENTS AND ADDITIONAL INFORMATION

Landrace

Wisdom Panel reports that these dogs are a landrace that are closely related to the Tibetan Mastiff.

Heterozygosity

“Most dog breeds have only been in existence for a few hundred years. Many exhibit limited genetic diversity, as dog breeds are typically descended from a small number of founders, created by crossing closely related individuals. Further, breeds often experience population bottlenecks as the popularity of the breed waxes and wanes. [Genetics and the Shape of Dogs, Elaine A. Ostrander, American Scientist](#)

The heterozygosity percentages provided in the report from Wisdom Panel are based on the typical range for purebred dogs.

Wisdom Panel has shared that the mixed breed dogs they have tested show a typical heterozygosity range of 33-46%. So almost all of the dogs tested are showing good genetic diversity while still expressing a typical phenotype for the Himalayan Mountain Dog (HMD).

While homozygosity is important to having traits that identify a breed, we should be cautious about making the assumption that the HMDs sampled have good genetic diversity or that the diversity can be maintained without introducing other dogs who are similar in appearance, temperament, and are used for the same purpose in other areas that are in the Himalayan Mountain region and Mongolia.

Health

All 14 dogs tested “clear” for **testable** genetic inherited diseases. This is good news, but keep in mind there are many diseases known to be inherited and at this time there is no DNA test available to detect carriers.

Of the 14 dogs tested, twelve were marked “inconclusive” for Progressive Retinal Atrophy (Shetland Sheepdogs). Wisdom Panel has advised us that this is not a cause for concern as it has only affected the Shetland Sheepdog breed. It is not uncommon for this result to show inconclusive in non-Shetland Sheepdog breeds.

Coat, Colors, and Markings

The Phenotypes

9 Black with tan points. 1 with a mask. Eight are smooth coat. One has furnishings (bearded).

1 Sable (fawn). Smooth coat.

2 Dominant Black. One is dilute (blue). Both are smooth coat.

1 Recessive Black. Smooth coat.

1 Recessive Red. Smooth coat.

Sable (fawn in Wisdom Panel (WP) report) and **dominant black**, are not well represented in this sampling, neither in genotype or phenotype. While this was a small sampling, it is not hard to see from the photos of dogs that are shared in native dog groups on Facebook that these two colors are not as common as the black with tan markings (at).

The two **dominant black** dogs are not carrying sable (fawn, ay) and the dog expressing recessive red is not carrying dominant black (recessive red is dominant over dominant black). One of the dominant black dogs has two copies of the **dilution allele (variant 3)** and is expressing the dilution as blue.

Two dogs tested has having **masks**. One of these dogs is expressing a mask. The second dog is recessive black so the mask is not seen.

Two dogs carry the **Piebald** allele and do not appear to be expressing it. One of the them is the dog with furnishings (bearded), so it is difficult to detect whether or not the dog is expressing the spotting because to the coat texture and length.

There are three dogs with the **recessive red alleles**. One dog has two copies and it is expressing it. The other two dogs have one copy. There are three variants of recessive red. This sample group only has variant number one.

Saddle tan is common in this sampling. There are 6 dogs carrying two copies but only one dog may be expressing it as creeping tan and was counted as expressing this trait. Link to information on saddle tan/creeping tan <http://www.doggenetics.co.uk/tan.html#saddle>

All of the three **chocolate variants** are present in the genotype of this sampling. None of the dogs are expressing it.

The **recessive red dog** tested had only one allele on the A Locus. It is assumed to be carrying **Agouti wild type** (aw). This is not currently testable, so it is assumed by Wisdom Panel (and others) when a dog has only one allele on the A Locus that the other allele is 'aw'.

Link to information about Agouti wild type. <http://www.doggenetics.co.uk/tan.html#wolfgrey>

Recessive Black and Black with Tan Points Alleles

This is in its own section because of the new information about the A locus and how the recessive black allele (a) seems to be "joined" with the black with tan points allele (at).

Two of the dogs tested at/at and are carrying recessive black (a). It is correct. There are three A Locus alleles being carried by these dogs. This is different than what was previously known about inheritance, that only two alleles can be present on each loci.

Wisdom Panel was asked about this oddity of having three alleles on one locus. They shared with the club that on the A Locus it has been found that when a recessive black allele is inherited it also brings a copy of the black with tan points allele (at). So any dog expressing recessive black will test as at/at **and** a/a. In the case of recessive black dogs the 'at' and 'a' are written as at-a/at-a.

Here is the link to the article they shared with us. Be sure to read the last paragraph.

<http://munster.sasktelwebsite.net/DogColor/agouti.html>

Wisdom Panel was asked if mating two recessive black dogs would result in recessive black and black with tan point puppies. They stated a mating of two recessive blacks appears to result in all the puppies being recessive black, citing the results of the matings of the recessive black dog breeds, such as the Belgian Shepherd, only resulting in recessive black puppies.

Traits

Floppy ears and the **high altitude gene EPASI** have interesting results. Six dogs have two copies of the floppy ear gene, eight dogs have one copy. All of the dogs that were tested have floppy ears. There does not seem to be a test for erect ears.

In the case of the **high altitude gene EPASI**, three dogs have 2 copies of this gene, nine dogs have one copy, and two dogs have no copies of this gene. Phenotypically, they all represent the HMD breed standard.

Wisdom Panel was asked about what seemed to be an anomaly in what we are seeing in ears and what we believed to be true about dogs from high altitudes. Wisdom Panel states it has been proposed that the **EPAS1 variant** isn't fixed within the relevant dog populations (including the Tibetan Mastiff). In which case, either by genetic drift or other means the variant will inevitably change in frequency. This is also the case with **floppy ears**. There may be other factors that influence ear carriage like thickness of the cartilage, size of the ear, and the amount of hair on the ear, which are currently not testable through DNA.

Here is a link to information on genetic drift. [Genetic Drift - Meaning, Types, Causes, Example and FAQ \(vedantu.com\)](http://vedantu.com/Genetic-Drift-Meaning-Types-Causes-Example-and-FAQ)

Eight of the 14 dogs tested had one copy of **long hair variant 1**. The remaining dogs have no long hair variants. It may be worth comparing the dogs tested to see if phenotypes seem to indicate this variant is influencing coat length.

Both Western and Eastern variants in **rear dew claws** are represented in this sampling. Wisdom Panel states that they phenotypically the same.

It is interesting that **Shedding traits** vary in this sampling.

Three dogs tested as "low shedding".

Two dogs tested with no reduced shedding,

One dog tested as "occasional" shedding.

Eight dogs tested as seasonal shedding.

Seasonal shedding is described by Wisdom Panel as dog's that shed twice per year. It has been reported by breeders that it is not uncommon that Tibetan Mastiffs shed heavily in the spring and then have a light shed in the fall.

Compiled by Marcha Garn for Himalayan Mountain Dog Club International

Attachment:

Graph from Wisdom Panel

WISDOM PANEL GRAPH

The dogs tested in this sampling, per Wisdom Panel, are a landrace. This graph shows they are closely related to the Tibetan Mastiff

NEPAL PROJECT 2022
BREED GRAPH FROM WISDOM PANEL
And
Email Information

