

## **Report on a pilot study of fleece types in the Hebridean breed of sheep.**

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The Hebridean Sheep Breed Description has this to say of the wool: *'A good dense weather-proof fleece, true black in colour is most desirable but fleece tips may become bleached by the sun giving a brown appearance. Some sheep go grey with age and this shows particularly on the coarser wool of the hindquarters.....It is purported to have a Bradford count of 48-50 and a staple length of 6-8 inches....'*

It was decided in the Spring of 2009 to conduct a pilot study to explore the fleece characteristics found within the Hebridean breed, to be carried out by the HSS 4 Horn Working Group. The results of this pilot study would determine whether or not a full scale survey was justified. Eight flock owners responded and sent in three samples from each of nearly one hundred animals, roughly equal numbers of two and multi horned. The samples were of a lock of wool taken either at shearing time or shortly before, so that the full staple length was obtained. Information was given for each animal about shearing date, horns and eyes, sex and age of the sheep, whether any copper supplement had been given or insecticide applied to the fleece (for handler safety) and the type of pasture soil. The results of analysis of some of the large amount of data generated are presented below, giving a description of the fleece according to its colour, length, range of crimp and whether or not it is double coated. A comparison is then made using these criteria between the fleeces of two and multi horned animals. It is intended that an expanded report to include more of the data collected will be published at a later date.

### **Initial assessment**

Fleece samples from the shoulder, flank and britch were taken from 87 sheep, making a total of 261 samples (a small number of samples had to be rejected from the initial number as they did not comprise the whole staple length). Each sample received was assessed for double coatedness, fibre length of hair and wool coats, crimp (curl) of the hair coat and the colour of each layer was noted. The colour, hair length, wool length and crimp were recorded for each sample along with details about the sheep including age, number of horns and any signs of copper deficiency. Colours were grouped into black, very dark, brown and grey. When assessing the wool layer, the colour was judged from deep within the staple.

The coarseness and handle of each sample was assessed both visually and by touch, but the diameter of fibres was not measured under the microscope. The crimp of the wool layer was not measured as this is visually similar throughout the breed and difficult to measure due to its fuzzy character. The crimp or curl of the top hair layer was measured in crimps per inch rather than per cm, a hand-spinning convention.

It was difficult to assess whether or not shearing fleece samples showed a double coat, so these were omitted from some comparisons. Not all flock owners had provided all the information requested, so there are fewer samples in some comparisons than in others.

### **Coat types**

Hebrideans are commonly accepted as being double coated, with a dense short wool layer which gives warmth, bulk and 'bounce' to the fleece, and a longer outer coat of guard hairs, which is the part we see. In our samples, it was found that these two layers were not always uniformly represented over the sheep: some sheep have both wool and hair layers throughout (fully double), a few have the

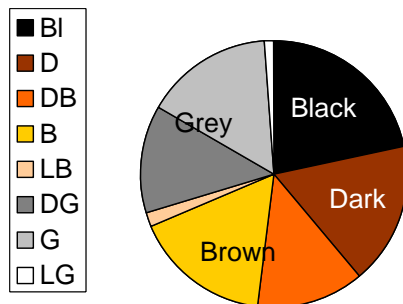
hair (outer) layer only, some have no hair layer over the wool and some have variable fleeces, with the hair coat present in patches. We found that 55% of the sheep had fully double coats, and 40% had uneven hair. Of the remaining 5%, 2 sheep had hair only, and 2 had wool only with no hair layer.

Type	Percentage	Number
Fully Double	55%	48
Hair Only	2.3%	2
No Hair	2.3%	2
Uneven Hair	40.2%	35
<i>Shoulder longer than britch</i>	(13.8%)	(12)
<i>Britch longer than shoulder</i>	(21.8%)	(19)

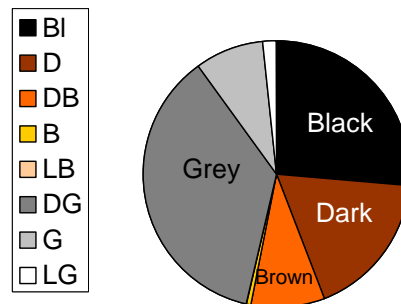
### Colours

Hair and wool layer colours were recorded in the following categories: Black; Dark; Brown (dark brown, brown or light brown); Grey (dark grey, grey or light grey). The distribution of colours of the individual hair and wool samples are shown in the pie charts below.

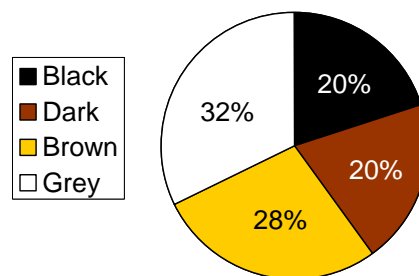
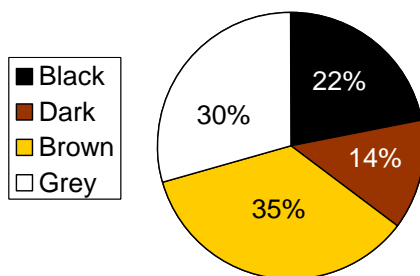
**Colour of Hair Samples**



**Colour of Wool Samples**



**Hair Colours for Fully Double Fleeces    Hair Colours for Uneven Fleeces**



We compared the colours of hair and wool samples and found much less brown in the wool layer. Brown appears to be caused by sun bleaching of darker fibres, which happens in the top, hair layer where that is present. The varying shades of grey reflect the different proportions of grey to other fibres and in the wool layer may include fleeces which are grey due to poor copper absorption; this shows as a grey band. A very few samples were mainly grey with fawn fibres.

As well as the 2 sheep which had no wool layer anywhere, some had hair only in one or two of their 3 samples. All of these hair only samples were either Black (60%) or Dark (40%). However, the hair samples\* from sheep with either fully double coats or uneven coats showed a variety of colours, the proportions of which are shown in the pie charts. Although the percentages of each colour vary

slightly between the fully double fleeces and the uneven fleeces, there is no significant difference in colour distribution between these two fleece types.

\* Samples from sheep of unknown age or yearlings were excluded.

### Colour, Length and Crimp

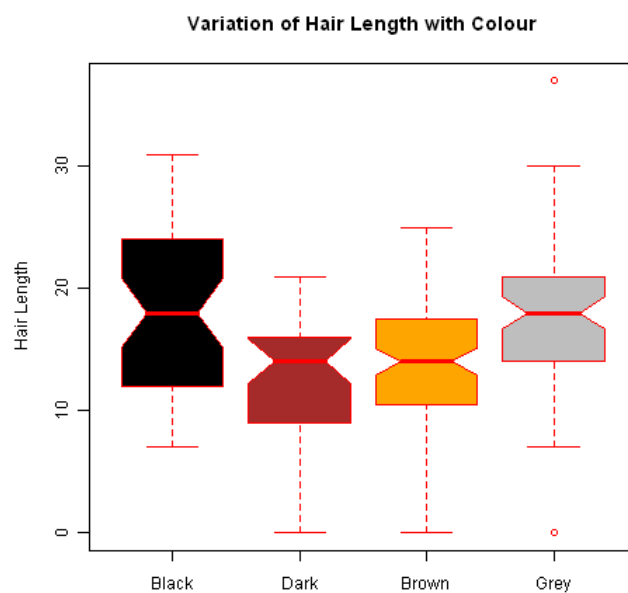
Hair length in the individual samples from the fleeces varies from very short or not present to the longest sample of 37cm. Averaging the hair length over shoulder, flank and britch per sheep shows that most sheep (68%) have hair between 12-22cm long.

Av. Hair Length	Percentage	Number
Long (23cm +)	8%	7
Medium (12-22cm)	68%	59
Short (4-12cm)	22%	19
Very Short (<3cm)	2%	2

Av. Wool Length	Percentage	Number
12-22cm	6%	5
8-12cm	34%	30
4-8cm	56%	49
0-4cm	3%	3

95% of the individual samples contained wool layers, the average wool length (when a wool layer was present) was 7.9cm and the maximum length recorded was 21cm. The distributions of average wool length (over shoulder, flank and britch per sheep) are shown above.

To investigate the relationship between hair colour and hair length, we considered the spread of hair lengths per colour type (Black; Dark; Brown or Grey). The plot below shows the distribution of hair lengths with colour; the upper and lower "Ts" represent the lengths of the minimum and maximum samples; the solid blocks represent the bulk of the samples and the notch shows the average value. "Outliers" (values that are outside the range of the others) are represented by separate circles.



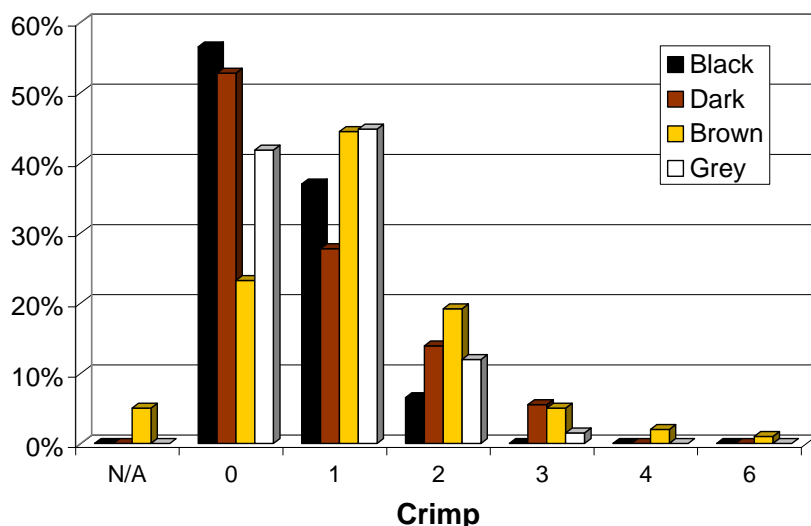
Black and Grey hair samples (average lengths of 18.1 and 17.5cm) were generally longer than Dark or Brown samples (12.5 and 13.8cm), and this difference is statistically significant.

Next we looked at the crimp of the hair layer. This varied from 0 (straight, 40% of samples) to 6 per inch (only 3% had 3 crimps per inch or more). Although there was a wide variation of hair length with crimp, longer hair (more than 12cm) was associated with less crimp (fewer than 2 per inch) and this association was statistically significant.

Crimp	Percentage of Samples	Average Hair Length
N/A	4%	0.0
0	40%	15.6
1-1.5	38%	16.5
2-2.5	13%	12.8
>=3	3%	11.7

The amount of crimp in a hair sample is also related to hair colour to some extent – 57% of black hair samples are straight, and less than 10% have a crimp of 2cm or more, whereas only 23% of brown hair samples are straight and 44% of them have a crimp of 1-1.5cm.

### Colour Type & Crimp

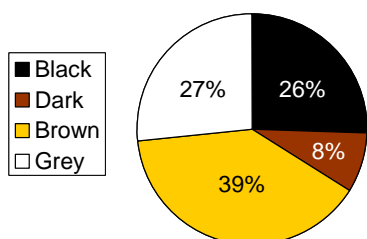


Overall we see that black hair tends to be longer and straighter than brown hair (which is shorter and has higher crimp).

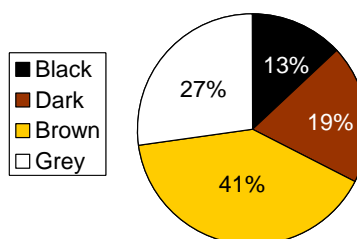
### Two Horned and Multi-horned sheep

Of the 87 sheep analysed, 37 were 2 horned and 50 were “multi-horned” (no horns, 4 horns, 5 horns or 6 horns). There was essentially no difference in the proportion of Brown and Grey hair samples between 2 horned and multi-horned sheep, however 19% of multi-horned sheep were Dark and 13% were Black, compared to only 8% Dark and 26% Black for two horned sheep.

#### Hair Colour in Two Horned Sheep



#### Hair Colour in Multi Horned Sheep



There was a slight difference in the average hair length between 2 horned and multi-horned sheep: 2 horned sheep tend to have longer hair (average = 16.7cm) than multi-horned sheep (13.4cm).

Average Hair Length	2 Horns	Multi Horns
Long (23cm +)	14%	4%
Medium (12-22cm)	65%	70%
Short (4-12cm)	22%	22%
Very Short (<3cm)	0%	4%
Average all samples	16.7	13.4

To see whether this difference is just due to the higher proportion of two horned Black sheep compared to multi-horned Black sheep (black hair is associated with longer hair, see above), we also compared the hair lengths within colour categories between the two and multi-horned sheep. We found that Black two horned sheep did indeed tend to have longer hair than multi-horned sheep, but there was no statistically significant difference in hair length between Dark, Brown or Grey two and multi-horned sheep.

Colour Type	Average Hair Length	
	2 Horns	Multi Horns
Black	19.8	15.5
Dark	11.6	12.9
Brown	14.7	13.1
Grey	18.7	16.7

Horns	2 Horns	Multi Horns
Fully Double	65%	48%
Hair Only	3%	2%
No Hair	0%	4%
Uneven	32%	46%

In terms of coat type: 65% of two horned sheep have fully double coats, compared to 48% of multi-horned sheep; also a lower percentage of two horned sheep (32%) have uneven coats compared to 46% of multi-horned sheep.

## Summary

From the data analysed, we have found a diversity of fleece types within the Hebridean breed, with 55% being fully double coated, 40% having at least some evidence of two layers and 5% having a single layer of either wool or hair.

There is a difference in the colours we see on the surface of the sheep and those found on parting the hair layer and looking into the wool. Around a third of the individual hair and wool samples examined are either dark or true black, with true black forming only around one fifth of the total number of samples, with only 8 out of the 87 animals in the study having true black fleece throughout. The apparent smaller proportion of grey fibres in the hair layer as shown in the pie chart reflects the increased proportion of brown in the hair when compared with the wool ; wool is not subjected to bleaching by the sun when a fully double coat is present. About half of all the wool samples show a degree of greying.

The fleece length variation within the breed, measured from the hair coat only is shown to be wide, from a tiny 3cm to the very longest which was 37cm. However, about two thirds of the samples fell within the range of 12-22cm (5-9").

Crimp is mainly in the range from absolutely straight to two crimps per inch, but a small percentage of animals show up to 6 crimps per inch. Black and Grey fleeces are more likely to be very straight than the browner types, as are longer hair coats. As well as a small number of fleeces lacking a top hair layer, it emerged that an equally small number of fleeces consist of only the top hair layer, with no under wool at all.

When comparing these characteristics between the samples collected from two and multi horned Hebrideans, we see that two horned animals have rather more black fleeces than multi horned sheep, but the proportions of lighter browns and greys are the same between the horn types. Four horned sheep have fewer very long fleeces than two horned and a very few have very short ones, although the longest sample came from a grey 4 horned ewe. Four horned sheep have significantly fewer fully

double coats than two horned; and of the variable length type more have britch wool which is longer than the shoulder wool than those which have longer shoulder wool than britch.

## **Comments**

The results from this small pilot study have highlighted some interesting facts about Hebridean fleece. However, we are conscious that the sample population was small, especially in that only eight flocks were represented. Within these flocks selection may already have taken place for favoured traits, or it may not. In order to get a truer picture of the Hebridean fleece and how it compares between two and four horned individuals, a wider scale study would need to be undertaken, visiting a much larger number of flocks. In light of the significant information already gathered, this is a worthwhile option. Of equal interest would be a longitudinal study of a number of individual sheep from birth to old age, following the changes which take place in the fleece over time.

Our thanks go to the eight flock owners who made the enormous effort required to collect and label their samples, most of which were taken during shearing, an already hectic time in the shepherd's calendar. We hope you feel it was worth it after reading the results of the study.

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