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Date: August 8, 2019
ABSTRACT

Qiviut is an expensive luxury fibre that is treasured by many handspinners. This In-Depth Project examines the characteristics of qiviut, and attempts to improve and extend the possibilities for using qiviut in handspun garments. This is done through a combination blending qiviut with other fibres and subsequently dyeing it, as well as bleaching qiviut to improve the colour palette available when blending and dyeing the fibre.

It was found that qiviut can be blended and the positive qualities of qiviut can be preserved in the blended yarn. In addition, bleaching qiviut can be successfully done at home. Furthermore, blending natural and bleached qiviut increases the colour palettes available and allows for a broader range for designing.
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1.0 INTRODUCTION

Muskox qiviut (pronounced kiv-ee-ute) is one of the finest and warmest fibers on earth. The muskox has adapted their extraordinary undercoat to protect them. Their down-like under hair is eight times warmer than wool by weight and finer than cashmere. Each spring the muskox sheds this two-part undercoat and it is harvested by separating the down from the long guard hair. The harshness and remoteness of the Arctic limits the amount of qiviut available. Domesticated herds supply small amounts but limited worldwide supplies make it one of the most sought after, expensive and treasured of all natural luxury fibers.

These qualities – limited supply, desirability and expense – led to examining qiviut for this Master Spinner In-Depth Project. Qiviut is acknowledged as a luxury fibre by handspinners and garment manufacturers. However, because of its high cost (current prices range from US$85.00 – US$150.00/100 gm [US$25.00 – US$45.00/oz] for cleaned roving) there is value in learning more about the fibre and how it blends with other fibres. Blending will certainly decrease the final cost of the yarn produced, but does the blended fibre retain the special qualities of qiviut? How do these blends change, enhance, improve or detract from qiviut’s natural characteristics? In addition, what about dyeing the qiviut? Can a handspinner successfully bleach qiviut without sending the fibre to a fibre processor? How does the bleached qiviut dye? These questions have been focused into the following research questions, which will be examined in this In-Depth Project:

- Will blending qiviut with other fibres improve the qualities of the final yarn produced?
- Can qiviut be bleached at home and, if yes, how well does the bleached qiviut blend with other fibres and subsequently dye?
- Does blending qiviut with other fibres improve the dyeability of the final yarn produced?

This report provides a brief background to the animal (Section 2) and then provides the characteristics of the fibre (Section 3). Section 4 describes the fibre types found on the muskox and provides a description of how the fibre should be prepared. Sections 6, 7, 8 and 9 provide information on carding, blending, spinning, dyeing and knitting respectively. Conclusions are found in Section 10.

All blended, dyed and knit samples are documented in Appendix I, which is found in Volume 1 and Volume 2. A record of the preparation and spinning methods are provided
for each sample. In addition, observation and analysis of the results of the dyeing and blending efforts is presented.
2.0 THE ANIMAL

About 90,000 years ago when the Bering Straits were dry land, muskoxen crossed into North America from Siberia. When the last glacier covered North America, muskoxen survived in ice-free areas in the northern Arctic islands and Greenland. As the ice retreated, they spread throughout northern Canada, Greenland and westward into Alaska.

Today their range and numbers are smaller. Of the estimated more than 100,000 muskox that roam the mainland tundra and Arctic islands in Canada (Danylchuk, 2006), most are found on the Arctic islands (Banks and Victoria islands), on the mainland in the area of Great Bear Lake up to the Arctic coast and in the Queen Maud Gulf area. They are also found in lesser numbers in the central Arctic. (Government of the NWT, 1999). They are also found in Greenland and Alaska, and there are a few domesticated herds.

Oomingmak, meaning “the animal with skin like a beard” in Inuktitut, is completely covered with dark brown to black hair except for the nose, feet, lips and horns (Photo 1). Most taxonomists list the muskox as *Ovibos moschatus* and it is classified with sheep and goats. The long over coat is composed of shaggy hair up to 65 cm (25 in) long, and covers the animal hanging nearly to the ground. The muskox has an underlayer of short, fine wool of exceptional warmth referred to as qiviut or qiviuq. This is the fibre that spinners are most interested in.

Source: http://www.taiga.net

Photo 1: Muskox in the High Arctic
It the adaptations the muskox has made to its harsh arctic climate that results in the qiviut being so desirable to handspinners. For eight months of the year, the muskoxen’s range is covered with snow. In the high Arctic islands four months of the year is spent in darkness in temperatures of $-30^\circ \text{C}$ and $-40^\circ \text{C}$. These temperatures are often combined with winds from frequent blizzards. The muskoxen’s two-layered coat conserves body heat. The conserved body heat causes the fine underlayer of qiviut to loft, forming millions of tiny air pockets insulating the body from cold. To maintain loft, qiviut must be clean and dry, so the underwool is protected from damaging weather and abrasion by a layer of course guard hair (Chambers, 1993; Government of the NWT, 1999). The fibre is such a good insulator that when biologists used aircraft-mounted infrared cameras to study them, the cameras picked up very little heat from the animals (CBC, 2003). The only place heat was observed to be lost on the animals was their horns and their eyes. Without this remarkable two-layered coat, muskox would never survive the extreme climate conditions and handspinners would not have a fiber that is finer than cashmere, warmer than wool and as light as eider down.
3.0 ABOUT THE FIBRE

The coat of the muskox is a composite of fibres. The coat consists of:

- **Guard Hair**: these are the long, stringy, course outer hair, often reaching 65 cm (25 inches) long, with texture similar to a horse’s tail (see Sample 1).
- **Under Hair**: this is quite fine and longer than qiviut; it is sometimes difficult to distinguish from qiviut but is generally curly at one end and strait at the other (see Sample 2).
- **Qiviut**: this is the soft undercoat or down (see Sample 3).
The characteristics of the qiviut are:

- **Warmth**: Qiviut is eight times warmer than wool. It is also a lightweight fibre. This means garments made for qiviut are light in weight but provide great warmth. It has been described as “… like wearing a cloud” (Globe and Mail, 2001). The yarn can loft up to three times its original diameter, increasing its softness and warmth.

- **Fineness**: Qiviut is a very fine fibre, with an average diameter of 11.4-15.3 microns. This compares to about 18 – 19 microns for cashmere and 30 microns for sheep’s wool (Chambers, 1993; Sparks, 1993; Globe and Mail, 2001).

- **Count**: According to the English quality system, the count for qiviut is between 100 and 140 in comparison to cashmere at 100 and camel down at 80 (Chambers, 1993).

- **Handle**: The qiviut fibre is very soft and has a good handle.

- **Heat Sensitivity**: The qiviut fibre has fewer scales than wool and does not shrink or felt easily with exposure to heat and agitation.

- **Luster**: The fiber has a good luster.

- **Strength**: Qiviut is a fairly strong fibre and compares favourably to wool for tensile strength.

- **Elasticity**: The fibre has no crimp, therefore lacks elasticity.

- **Fibre Length**: The average fibre length range is from 1.5 – 6 inches (Sparks, 1993).

- **Chemical Reaction**: The fibre is sensitive to bleaching.

- **Sunlight Resistance**: The fibre is susceptible to degradation in sunlight; it will bleach to a creamy-white colour with prolonged exposure to sunlight.

- **Receptiveness to Dye**: The natural coloured and bleached fibre is very receptive to dye.

- **Grease Content**: The unscoured raw fibre has a low grease content of about 6.8%, compared to a wool average of 20% (Sparks, 1993).

- **Susceptibility to Insects**: The fibre is susceptible to moths.

- **Abrasion**: The fibre’s fineness gives yarn a loft, but also represents that fact there are millions of fibre ends. The lofting quality causes the ends to stand up and the abrasion of wear causes pills to form. These can be combed off, but will reappear with additional wear (Chambers, 1993).

- **Cost**: The fibre is very expensive. Current prices (2006) for dehaired roving range from US$85.00 – US$150.00/100 gm (US$25.00 – US$45.00/oz).
4.0  FIBRE PREPARATION

4.1  Grades of Qiviut

Qiviut grows in an even coat over the entire body of the muskox without forming distinct locks (Photo 2). It is downy, soft and has a silky gloss. Prime-quality qiviut – with the longest and finest fibres and the fewest guard hairs – comes from the front shoulder area. The next quality comes from the sides. Medium quality, which is shorter, coarser and harder to comb out, comes from the rump, front haunch and belly. The poorest quality, which is usually dry and mixed with broken guard hair and scurf, comes from the haunch and saddle – the most exposed areas of the body (Chambers, 1993).

Source: http://www.taiga.net/wmac/species/muskox/populationandlocation.html
(Ken Madsen)

Photo 2: Muskox Coat Showing Lack of Distinct Locks

The fibre is available in many different states of preparation. The poorer the preparation, the more time will be spent in preparation for spinning. The poorest quality preparation is “found qiviut” - obtained when the muskox sheds and the qiviut is collected from the tundra (see Sample 4). This qiviut is weathered, bleached, suffers from exposure to the sun and moisture and will contain foreign matter. Found qiviut is also very harsh to the touch. Cleaning it, i.e., picking out the vegetation, debris, weathered fibre, is very time consuming. Up to 50% of fibre collected from the tundra can be lost during cleaning. Unless this is the only source of fibre available to a spinner, it is almost not worth the effort needed to use it.
The next quality is qiviut that has been clipped or shaved from the hide. It is shorter and therefore less desirable to spin (see Sample 5). Finally, the highest quality is qiviut that has been combed from the hide (see Sample 3).

4.2 Combing Qiviut from the Hide

It is easiest to comb the fibre from a frozen hide. Lay the hide on the floor or clamp it to a table. Using a pick or fork, comb out the fibres towards you with one hand while the other hand steadies the hide. After the fork is full, pull the qiviut out and place it in a bag. Removing all the long hairs at this stage saves picking time later.

4.3 Washing the Qiviut Fibre

After removing fibre from the hide, it should be washed. Washing removes skin, bacteria and traces of blood that can cause fibre break down over time. It is not recommended to wash loose fibre because the fibres lack ridged scales and do not remain locked together in staples as wool fibres do, but float freely in the water. Because they are so fine, they seem to disappear when put in water. To eliminate the loss of the qiviut, the fibre should be placed in a mesh bag to eliminate the loss of qiviut.
Using a neutral soap such as orvus paste and warm water, soak the fibre for at least 30 minutes to allow for a thorough wetting and soap penetration, rinse with warm to cool water, squeeze out the excess moisture and spread out to air dry.

4.4 Removing Guard Hair and Under Hair

The guard and under hair must be removed from the fibre before spinning, or the result will be an itchy garment that will not be pleasant to wear. The guard hair is easy to distinguish, as they are stiff, coarse, wiry and quite long (up to 65 cm or 25 inches) causing them to poke out of a mass of fibres (see Sample 1, previously shown). The under hair is more problematic to remove. They are darker than the qiviut (see Sample 2, previously shown), and are springy when placed under slight tension (Sparks, 1993). Taking the time to remove the guard and under hair from the qiviut will produce a superior yarn.

A few tools are required to remove the guard and under hair: a very good light source, small sharp scissors, tweezers and a light-coloured lap cloth. Picking the qiviut refers not only to the removal of guard and under hair, but also the remaining of any remaining bits of dandruff and debris. These bits of dandruff tend to be on the skin side of the fibre mass and can be removed by snipping with scissors or tweezers.

To pick out the guard and under hair, spread the lap cloth over your lap. Take a small mass of fibre and hold it up to the light and spread the fibres apart. Do not underestimate the time it takes to pick out the guard and under hairs and do not estimate how hard it can be on your eyes. There could be up to a 30% weight loss from guard and under hair removal (Pepin, 1989).
5.0 FIBRE BLEACHING

There was no guidance in the literature reviewed that provided direction on bleaching dark protein fibres. Three methods of bleaching qiviut were tried: household bleach, household hydrogen peroxide and off-the-shelf hair bleach.

5.1 Household Bleach

Household bleach (5.25% sodium hypochlorite) was used in varying strengths and varying immersion times. The following recipes were used:

- Eight tablespoons of bleach/litre of water at room temperature for 30 minutes. This bleach recipe disintegrated the fibre as shown in Sample 6.
- Four tablespoons of bleach/litre of water at room temperature for 30 minutes. This recipe disintegrated the fibre as shown in Sample 7.
- Two tablespoon of bleach/litre of water at room temperature for 60 minutes. The fibre in this sample is slightly lightened in colour as shown in Sample 8. However, it is harsh to the touch. When the ear test is performed, it is noticeably brittle and weakened.

One teaspoon of bleach/litre of water at room temperature for 60 minutes. After 60 minutes, one additional teaspoon of bleach was added for a further 60 minutes. The fibre in this sample is slightly lightened in colour as shown in Sample 10. However, it is harsh to the touch. When the ear test is performed, it is noticeably brittle and weakened.

Sample 6
Eight Tablespoons Bleach/Litre of Water for 30 Minutes

Sample 7
Four Tablespoons Bleach/Litre of Water for 30 Minutes
All samples were slightly lightened and noticeably harmed. Two of the recipes (Sample 7 and Sample 8) disintegrated the fibre. Using household bleach qiviut was not successful.

### 5.2 Household Hydrogen Peroxide

Household hydrogen peroxide (10% Vol. U.S.P. 3% W/V) was used in varying strengths and various immersion times. The following recipes were used:

- One teaspoon of household hydrogen peroxide/litre of water at room temperature for 60 minutes. See Sample 10.
- One-hundred percent household hydrogen peroxide at room temperature for 30 minutes. See Sample 11.

Although the samples are slightly lighter than the natural qiviut, there is substantially no colour difference between the samples or between the samples and the natural colour of the qiviut. The samples that have undergone hydrogen peroxide immersion are slightly weakened, but not as noticeably as the household bleached samples. Using household hydrogen peroxide to bleach qiviut was not successful.
5.3 Off-the-Shelf Hair Bleach

An off-the-shelf hair bleach, Perfect Blondissima Crème by L’Oreal, was chosen to bleach the qiviut (Photo 3). Ingredients include: potassium persulphate, sodium metasilicate, sodium persulfate, ammonium chloride, hydrogen peroxide, alcohol, calcium stearate, aqua, propylene glycol, pentasodium pentetate, and behentrimonium chloride. According to the product information, dark hair can be turned noticeably lighter or blond with this product. Apparently, one can apply a light blonde hair colour (ash, beige, golden, neutral) after lightening to give a more sophisticated, refined shade or leave it "bleached" to make a trendy, bold statement (L’Oreal, 2006). This sounded perfect for bleaching muskox and subsequently dyeing it.

The product instructions were followed. The hair bleach was mixed and applied to the qiviut and left for one hour. The qiviut, guard and under hair were all bleached to a creamy white (see Sample 13). The sample that has undergone bleaching with hair bleach does not appear to be weakened. Using off-the-shelf hair bleach to bleach qiviut was successful.
Photo 3: Bleaching Qiviut with Perfect Blondissima Crème by L’Oreal

Sample 12
Muskox Bleached with
Off-the-Shelf Hair Bleach
6.0 FIBRE CARDING AND BLENDING

6.1 Carding

Qiviut can be spun directly from the picked fibre without carding. However, if the picked fibre shows colour differences, it is recommended that a light carding be done to blend the colour variations which will reduce the colour streaking in a final garment. An example of the range of colours that can appear in qiviut can be seen by examining Sample 3 and Sample 5, both previously shown.

If using hand cards, fine cotton carders (not wool cards) should be employed. Because carding contributes to the formation of noils, the fibre should be carded lightly with only a few card exchanges. While carding, static electricity can be a problem so occasionally lightly spraying the fibre with water might be necessary. If using a drum carder, a fine drum (merino drum or fur drum) works best. If it is available, use a slow drum carder speed and send the fibre through only once. Remove the fibre from the carder in a rolag or puni.

6.2 Blending

Qiviut lends itself to blending with almost any fibre. This project blends qiviut with fibres as diverse as wool, rayon, silk, cotton and alpaca.

Before beginning to blend, the spinner should consider the reasons for blending as well as what qualities are important to the final product. Reasons for blending qiviut with another fibre include:

- improve the hand of another fibre
- improve warmth of another fibre
- decrease the warmth of qiviut
- add elasticity to the qiviut
- add an exotic touch to a special project
- decrease the cost of a finished article
- increase the colour palette available for dyeing by blending it with a light-coloured or white fibre

Qiviut can be combined with other fine protein fibres that are less expensive, such as yak and alpaca. This extends the limited supply of qiviut while preserving its softness, fineness and some of its warmth.
Wool, although coarser than qiviut, is a very versatile and wearable fibre. It will add elasticity and memory for shape, make the fabric less warm as well as improve the drape. A fine high-count fleece such as Merino or Corriedale combines well with the weight, staple length and fibre diameter of the qiviut. Blending with wool will also help reduce pilling.

The feel of silk, soy silk and rayon are very compatible with qiviut. Blending qiviut and these fibres will produce a smoother, sleeker yarn with great luster and good body. It will not, however, increase the elasticity or memory for shape of the final garment.

Any percentages can be blended successfully. As with a consideration of fibre characteristics, the spinner must consider the reason for blending. If the purpose is to add elasticity to the qiviut blend, then a 20% or 30% blend of fine wool with qiviut would suffice. If the purpose is to add elasticity as well as considerably decrease the cost of the final product, a 60% or 70% blend of fine wool with qiviut might be more appropriate. If the spinner is looking at increasing the warmth of a fibre, then a 20% or 30% addition of qiviut to cotton might work. Even when there is only 20% qiviut present in the blend, the qiviut dominates the feel of the yarn because of its lightweight and its ability to loft over the other fibres.

To avoid streaking of the final article, it is advisable to carefully weigh all fibres. Two or more carder exchanges are required to successfully blend the fibres. This must be done carefully because qiviut is prone to noils when it is over-carded.

Table 1 identifies the blended samples prepared. The Sample Cards are found in Appendix I, which is located in Volume 1 and Volume 2.

### Table 1: Qiviut Blends

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Blend</th>
</tr>
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<tbody>
<tr>
<td>Sample Card 1</td>
<td>100% Qiviut</td>
</tr>
<tr>
<td>Sample Card 2</td>
<td>100% Bleached Qiviut</td>
</tr>
<tr>
<td>Sample Card 3</td>
<td>Commercial Blend 70% Merino, 30% Qiviut</td>
</tr>
<tr>
<td>Sample Card 4</td>
<td>70% Qiviut, 30% Merino</td>
</tr>
<tr>
<td>Sample Card 5</td>
<td>75% White Corriedale, 25% Bleached Qiviut</td>
</tr>
<tr>
<td>Sample Card 6</td>
<td>80% Moorit Corriedale, 20% Qiviut</td>
</tr>
<tr>
<td>Sample Number</td>
<td>Blend</td>
</tr>
<tr>
<td>---------------</td>
<td>-------</td>
</tr>
<tr>
<td>Sample Card 7</td>
<td>75% Qiviut, 25% Bombex Silk</td>
</tr>
<tr>
<td>Sample Card 8</td>
<td>75% Bombex Silk, 25% Qiviut</td>
</tr>
<tr>
<td>Sample Card 9</td>
<td>45% Qiviut, 45% Merino, 10% Bombex Silk</td>
</tr>
<tr>
<td>Sample Card 10</td>
<td>40% White Polwarth, 40% Tussah Silk, 20% Bleached Qiviut</td>
</tr>
<tr>
<td>Sample Card 11</td>
<td>80% Black Merino, 15% Qiviut, 5% Silk Noil</td>
</tr>
<tr>
<td>Sample Card 12</td>
<td>68% Black Alpaca, 16% Qiviut, 16% Black Merino</td>
</tr>
<tr>
<td>Sample Card 13</td>
<td>68% Alpaca, 16% Corriedale, 16% Qiviut</td>
</tr>
<tr>
<td>Sample Card 14</td>
<td>66% Yak, 34% Qiviut</td>
</tr>
<tr>
<td>Sample Card 15</td>
<td>85% Soy Silk, 15% Qiviut</td>
</tr>
<tr>
<td>Sample Card 16</td>
<td>85% Viscose Rayon, 15% Qiviut</td>
</tr>
<tr>
<td>Sample Card 17</td>
<td>66% Fox Fibre (Green) Cotton, 15% Qiviut</td>
</tr>
</tbody>
</table>
7.0 SPINNING

When spinning 100% qiviut, its best properties are displayed if the yarn is spun fine with a high twist per inch (tpi). Literature (Sparks, 1993; Chambers, 1993) suggests about 14 tpi in the singles and about 9 tpi in the ply. If it were to be used for a warp yarn, a little more tpi would be required.

Because of the fibres natural loft, the plied yarn will be about three times the diameter of the singles (Sparks, 1993; Chambers, 1993; Baker, 1990). Fine singles that look about the size of a sewing thread will look more substantial when plied. Dyeing the yarn and/or continued handling of the yarn, i.e., dyeing, knitting or weaving the garment, encourages further lofting.

Either a long draw or short draw can be used for spinning qiviut. Both techniques need a firm tension; spinning a worsted-type yarn keeps the loose fibre ends under control. Although qiviut is strong, it needs a lot of twist to hold the smooth fibres together. Insufficient twist will allow the fibres to slide past each other with resulting in a weak yarn and a garment that could stretch out of shape. Overtwist should be avoided. When too much twist has been added, the yarn will break due to the extreme fineness of the fibre.

All samples are found in Appendix I located in Volumes 1 and 2. A record of fibre preparation and spinning methods is provided for each sample. As well, each sample was assessed for tpi, count and yards per pound (YPP). The greatest percentage of the type of fibre in the sample determined the count system used, and qiviut was considered to be wool in this determination. For instance, a worsted spun 100% qiviut sample count was calculated using the worsted (English system) count, while a 75% silk/25% qiviut sample was calculated using silk (English system) count. Each sample has also been described using the normal yarn guide nomenclature, e.g., lace weight and sport weight. These formulae and the yarn guide are found in Appendix II located in Volume 1 and Volume 2.
8.0 DYEING

Qiviut fibre dyes very well. However, due to its brown colour, 100% natural qiviut cannot be dyed light colours. It is nearly impossible to achieve yellows and light values when dyeing 100% natural qiviut. Blending qiviut with lighter coloured fibre or bleaching qiviut increases the colour palette available for dyeing.

Qiviut can be dyed with any natural or chemical dyes suited to protein fibres. It requires frequent stirring to ensure even take-up of the dye. The samples for this In-Depth Project were dyed using both chemical dyes and natural dyes. All samples were dyed after spinning because of the difficulty of keeping track of the unspun fibres after they are immersed in water. Although it will not shrink, qiviut should be treated with care when wet because the increased weight could cause the yarn to pull apart (Chambers, 1993).

All dyed samples are in Appendix I, found in Volume 1 and Volume 2.

8.1 Chemical Dyes

Acid wash dyes (Ciba and Dekka brands) were used for dyeing the qiviut and qiviut-blend samples. Four colours were chosen as follows:

- salmon – dyed at 5% depth of shade (DOS)
- turquoise – dyed at 6% DOS
- gold – dyed at 4% DOS
- red – dyed at 3% DOS

Literature suggests that a 1 – 2% DOS is sufficient to overcome the natural colour of the fibre (Chamber, 1993), however a deeper DOS was used for these samples. The chemical dye recipe used is presented in Appendix III found in Volume 2.

8.2 Natural Dyes

Logwood and cochineal, with an alum/cream of tartar mordant, were used as follows:

- cochineal at 80% WOG
- logwood at 200% WOG

The natural dye recipes used are presented in Appendix III found in Volume 2.
9.0 KNITTING

The most successful products made of 100% qiviut are scarves, head coverings and shawls – items where warmth is important, softness is desirable and sensuous cling is appealing (Chambers, 1993). Shape retention is not important in these garments and the fiber’s lack of elasticity does not become an issue.

Using 100% qiviut for larger garments such as sweaters is less successful (Chambers, 1993). This is mainly because the lack of elasticity (which invites growth) and qiviut’s lack of ability to withstand a lot of wear and abrasion. For larger knitted garments, it makes a lot of sense to combine qiviut with other fibers through blending, plying or mixing in the construction. The blend can enhance the visual appeal as well as the wearability of the fabric. Chamber (1993) and Pepin (1989) recommend the following techniques when knitting with qiviut:

- plan to make 100% qiviut items that will not have excessive wear, such as hats, scarves, shawls
- carefully plan larger pieces of 100% qiviut by:
  - using a fine yarn spun that has adequate twist to prevent stretching and to reduce fuzzing
  - trying to keep the garment to under 200 gm (7 oz)
  - allowing for at least 2.5 cm (1 inch) stretch in the length of sleeves
- use the following techniques to help the garment hold its shape:
  - two-colour Fair Isle knitting or other stranded techniques
  - use facings which are turned under and sewn
  - run elastic through facings or ribbings
  - blend qiviut with other fibres
  - use qiviut in intarsia patterns, but avoid putting the qiviut in areas where it needs help to maintain the garment’s shape or withstand a lot of wear (sleeves, waistband, underarms)

All knit samples are in Appendix I found in Volume 1 and Volume 2.
10.0 CONCLUSION

10.1 Blending Qiviut

Pure qiviut is a true luxury fibre. Its positive qualities include its amazing fineness, softness and its gentle loft. Its negative qualities include its extreme warmth, lack of elasticity and very high cost. Because of these qualities, garments made from 100% qiviut need to be very well planned and executed.

The numerous sampling conducted for this In-Depth Project demonstrates that blending qiviut with other fibres can improve the qualities of the final yarn. Depending upon fiber preparation, when qiviut is blended with fine wool such as Merino or Corriedale, or with a combination of fine wool the blended yarn has the best qualities of both of the constituent fibres. It will add elasticity and memory for shape, make the fabric less warm as well as improve the drape. This is well demonstrated in the in Sample Card 4 (70% Qiviut/30% Merino), Sample Card 5 (75% White Corriedale/25% Bleached Qiviut) and Sample Card 6 (80% Moorit Corriedale/20% Qiviut), as well as Sample Card 13 (68% Alpaca/16% Corriedale/16% Qiviut), Sample Card 9 (45% Qiviut/45% Merino/10% Bombex Silk) and Sample Card 10 (40% White Polwarth/40% Tussah Silk/20% Bleached Qiviut). It was found that with as little as 20% qiviut in a blend, qiviut can still dominate the feel of the yarn.

Qiviut can also be combined with other fine protein fibres that are less expensive, such as alpaca, silk and yak (see Sample Card 7 - 75% Qiviut/25% Bombex Silk; Sample Card 8 - 75% Bombex Silk/25% Qiviut; Sample Card 12 - 68% Black Alpaca/16% Qiviut/16% Black Merino; Sample Card 13 - 68% Alpaca/16% Corriedale/16% Qiviut; Sample Card 14 - 66% Yak/34% Qiviut). This extends the limited supply of qiviut while preserving its softness, fineness and some of its warmth.

The feel of silk, soy silk and rayon are very compatible with qiviut. Blending qiviut and these fibres produces a smoother, sleeker yarn with great luster and good body. It does not, however, increase the elasticity or memory for shape of the final garment (see Sample Card 7 - 75% Qiviut 25% Bombex Silk; Sample Card 8 - 75% Bombex Silk/25% Qiviut; Sample Card 15 - 85% Soy Silk, 15% Qiviut; Sample Card 16 - 85% Viscose Rayon/15% Qiviut).

Blending the natural coloured qiviut with another naturally coloured fibre, such as black alpaca or black Merino (see Sample Cards 11 and 12) or green Fox Fibre cotton (Sample Card 17) or the indigo dyed viscose rayon (sample 16) resulted in a pleasant surprise. The
brown of the qiviut muted the darker black, blue and green resulting in a “tactile” colour in the blended yarn. The brown colour of the qiviut presents a distinct brown-coloured halo on these samples.

The one commercial blend that was used in this In-Depth Project (Sample Card 3 - 70% Merino, 30% Qiviut) was over-processed. This shows the necessity to ensure that a mill understands the type of fibres they are processing.

10.2 Bleaching Qiviut

Bleaching qiviut to obtain a lighter colour can be successfully done at home. Using household bleach and household hydrogen peroxide to bleach the qiviut was not successful (see Samples 6 to 11 in this report); however using off-the-shelf hair bleach was successful (see Sample 12 and Sample Card 2).

The qiviut is not bleached pure white, but is bleached a pleasant creamy off-white. The amount of qiviut that can be bleached with each package of hair bleach depends on the quantity of bleaching agent in the hair dye package purchased and the desired lightness of the fibre. Bleaching the qiviut is a simple process and it is an easy step to incorporate into a project if the designer wants to obtain light or pure colours in the final product.

10.3 Dyeing Qiviut

Qiviut takes a dye very well. However, because of qiviut’s dark colour, the fibre cannot be overdyed to obtain light colours. Blending qiviut with other fibres can improve the colour palette available for dyeing.

When qiviut is blended with a dark fibre (Sample Card 6 - 80% Corriedale (moorit)/20% Qiviut) the dyed colours are a bit dark as would be expected when overdyeing a medium shade of brown. When this blend is dyed a light colour, i.e., cochineal and salmon, there tends to be a tweed effect.

When the natural-coloured qiviut is blended with a lighter fibre, e.g., Sample Card 4 - 70% Qiviut, 30% Merino and Sample Card 8 - 75% Bombex Silk, 25% Qiviut, the dyed yarn still displays the effects of the brown-coloured qiviut. However, the samples show that the greater the percent of light fibres in the blend results in obtaining more pure and lighter colours when dyed. This is well demonstrated when comparing Sample Card 8 - 75% Bombex Silk/25% Qiviut and Sample Card 7 - 75% Qiviut/25% Bombex Silk.
The real success at obtaining pure and light colours occurs when the bleached qiviut was dyed. The 100% Bleached Qiviut sample (Sample Card 2) shows it is easy to obtain light colours that are pure and strong without the tweedy effect that is evident in the 100% Qiviut sample (Sample Card 1). Blending the bleached qiviut with a white or light fibre (Sample Card 5 - 75% White Corriedale/25% Bleached Qiviut; Sample Card 10 - 40% White Polwarth/40% Tussah Silk/20% Bleached Qiviut; Sample Card 14 - 66% Yak/34% Qiviut) is also successful. Using bleached qiviut, whether it is 100% or blended with another fibre, expands the possibilities of designing a garment with a broad range of colours.
11.0 RESOURCES USED


APPENDIX I

BLENDED, SPUN, DYED AND KNIT SAMPLES
Sample Card 1
100% Qiviut
100% Natural Qiviut

Fibre
100% natural qiviut, combed from the hide.

Preparation and Spinning Methods
Two samples were prepared and spun. Sample 1 was combed on mini combs, spun directly from the combs worsted style (zzS). It was spun to a baby weight yarn (2900 ypp; 10.4’s using worsted wool count system). Because of the preparation, the fibre spun very easily and the resulting yarn was smooth and even when compared to Sample 2.

Sample 2 was not carded. The fibre was picked to remove remaining guardhair and underhair, and then fluffed to attenuate and separate the fibres. It was spun worsted style (zzS) to a DK weight yarn (1,200 ypp; 4.3’s using the worsted wool count system). Due to the lack of preparation, the resulting yarn was uneven and bumpy when compared to Sample 1.

Dyeing
Qiviut takes a dye very well. Because of its naturally dark colour, the fibre cannot be overdyed to obtain light colours. The logwood, cochineal and salmon-coloured samples provide a subtle change from the natural colour of qiviut. The gold, turquoise and red dyes are relatively strong and overdyed the natural colour of the qiviut quite well. The gold and salmon provide a pleasant tweedy effect to the yarn.

Knitting
Sample 1 was knit in an adapted Spanish Leaf pattern on 3.75 mm needles. Sample 2 was knit in a Stockinette Stitch on 3.00 mm needles.

Discussion of the Blend
Pure qiviut is very silky. The yarn feels smooth, soft and luxurious and its appeal is more tactile than visual. With time and wear, it will loft nicely, but will not have the characteristic “fuzziness” of angora. Because qiviut has no elasticity, any garment to be made from this blend must be well thought out and well designed. For example, a heavy-weight yarn of 100% qiviut knit into a sweater will grow alarmingly. As well, the cost of a larger garment such as a sweater that was made from 100% qiviut would be high.

The lace weight sample (Sample 1) weight would be good for a scarf or soft shawl. The DK weight sample (Sample 2) in the Stockinette Stitch shows off the fibre nicely. This sample weight would be a good weight for a hat, scarf or vest. Designing a smaller article such as a vest would keep the weight of the article to a minimum minimizing the stretching of the finished article.
Natural

Logwood

Cochineal

Salmon

Gold

Red

Turquoise
Sample Card 2

100% Bleached Qiviut
100% Bleached Qiviut

Fibre
100% qiviut combed from the hide and bleached

Preparation and Spinning Methods
This sample combed on mini combs then spun directly from the combs worsted style (zzS). It was spun to an Aran weight yarn (1680 ypp; 6.1’s using worsted wool count system).

Because of the preparation, the fibre spun very easily and the resulting yarn was smooth and fairly even.

Bleaching
The qiviut was bleached using off-the-counter commercial hair bleach (Perfect Blondissima Crème by L’Oreal). The bleached fibres are a creamy-white and as soft as qiviut that has not been processed.

Dyeing
The bleached qiviut takes a dye very well. It is very easy to obtain light colours. When compared to the dyed natural qiviut (Sample Card 1), the bleached qiviut’s colours are pure and strong with no tweedy effect.

Knitting
The sample was knit in the pattern Little Flowers using 2.25 mm needles.

Discussion of the Blend
Pure qiviut is very silky. The yarn feels smooth, soft and luxurious and its appeal is more tactile than visual. With time and wear, it will loft nicely, but will not have the characteristic “fuzziness” of angora. Because qiviut has no elasticity, any garment to be made from this blend must be well thought out and well designed. For example, a heavy-weight yarn of 100% qiviut knit into a sweater will grow alarmingly. As well, the cost of a larger garment such as a sweater that was made from 100% qiviut would be high.

The knit sample pattern provides a bit of laciness to the garment while still showing off the fibre. It would be a good weight for a hat, scarf or vest. Designing a smaller article such as a vest would keep the weight of the article to a minimum minimizing the stretching of the finished article.

Bleaching qiviut is a simple process and recommended if one wants to offset the colour of the natural qiviut, have light or pure colours, or wants to blend qiviut with a light-coloured fibre and does not want to have a tweedy effect when dyeing.
Sample Card 2
- 100% bleached qiviut
- combed on mini-combs
- spun directly from mini-combs worsted style (zzS)
Sample Card 3
Commercial Preparation
70% Merino
30% Qiviut
Commercial Preparation
70% Merino,
30% Qiviut Blend

Fibre
70% Merino, 30% Qiviut (Commercial Preparation)

Preparation and Spinning Methods
This blend was a commercially prepared roving with a lot of noils and some tangles, which may indicate that the fibre was over-processed. For these samples, the commercially-prepared roving was put once through the slow intake of a Beverly drum carder using a fur drum before spinning. The resulting roving was then spun worsted style (zzS). Two weights of yarn were spun: one was used for the knit sample and one was used for the dyed samples. The knitting was spun to a baby weight (2600 ypp; 9.2’s using worsted wool count system). The dyed samples were spun to a DK weight (1100 ypp; 4.7’s using worsted wool count system).

The commercial preparation was not particularly pleasurable to spin even after it had been re-carded.

Dyeing
Both qiviut and merino take a dye very well. The blended colour before dying is a light brown and quite dull. The uneven blending in this preparation results in most of the dyed samples having a tweedy effect.

Knitting
The knit sample knit in the pattern Razor Shell on 3.75 mm needles.

Discussion of the Blend
Merino is very fine, has a well defined crimp and a soft handle. The separate characteristics of the merino and qiviut would lead one to believe the blended yarn would produce a fibre that contains the best qualities of both fibres: elasticity, softness and loft. The final yarn does have a lot of elasticity, but it is not soft and has no loft. This lack of softness and loft is likely a function of the commercial preparation.

The 70% merino in the blend will cut down on the warmth of the qiviut, provide the much needed memory to the yarn and will result in a yarn that will be able to withstand a wear and abrasion. As well, the cost of the garment would be reduced when compared to a pure qiviut garment. This blend will lend itself to an outer garment or a sweater and would be fine for baby use.
Razor Shell
Sample Card 4

70% Qiviut
30% Merino
70% Qiviut
30% Merino Blend

Fibre
70% Qiviut, 30% Merino

Preparation and Spinning Methods
The fibres were blended on the slow intake of a Beverly drum carder using a fur drum. First, each fibre was put through the drum carder separately, then weighed and then blended on the drum carder. It was spun worsted style (zzS), 4.5 tpi at a DK weight (1200 ypp; 4.3’s using worsted wool count system).

This was well blended and well prepared. The bat was pulled out into a roving, attenuated and spun. The preparation was very easy to spin.

Dyeing
Even though the natural colour of the qiviut dominates the colour of this blend, because it was blended so well, there is little tweedy effect in the dyed samples. The lighter colours, i.e., logwood, cochineal, salmon and gold, do display this effect. The dark colours, i.e., turquoise and red, are quite strong in this blend.

Knitting
The sample was knit in a stockinet stitch on 3.25 mm needles.

Discussion of the Blend
Merino is very fine, has a well defined crimp and a soft handle. In this blend and preparation, the separate characterises of the merino and qiviut produces a yarn that contains the best qualities of both fibres: elasticity, softness and loft. Because of the 70% qiviut in this blend, it would still be quite warm and may not wear well. As well, the cost of the garment will still be quite high. If I spun this blend again, I would spin at a smaller grist (fingering, baby or lace weight) and knit the yarn in an open lacier pattern.

This blend would be best for hats, shawls, scarves, mittens or a vest. It is soft enough for baby use.
Stockinette Stitch
Sample Card 5

75% White Corriedale
25% Bleached Qiviut
75% White Corriedale
25% Bleached Qiviut

Fibre
75% White Corriedale, 25% Bleached Qiviut

Preparation and Spinning Methods
The fibres were blended on the slow intake of a Beverly drum carder using a fur drum. First, each fibre was put through the drum carder separately, weighed and then blended on the drum carder. It was spun worsted style (zzS), 4 tpi at an Aran weight (750 ypp; 2.65's using worsted wool count system).

This sample was well blended and well prepared. The bat was pulled out into a roving, attenuated and spun. The preparation was very easy to spin.

Dyeing
The blend of white Corriedale and bleached qiviut takes a dye very well. The colour of these samples should be compared to the 70% white Merino/30% natural qiviut blend (Sample Card 4). If one wants to have a wool and qiviut blend as well as obtain clear colours when dyeing, then using bleached qiviut would be the choice to make. When compared to the 70% white Merino/30% natural qiviut blend, this blend’s colours are pure and strong. The pale colours of the logwood and cochineal work are very clear this blend.

Knitting
The sample was knit in a forward cable pattern on 3.75 mm needles.

Discussion of the Blend
Corriedale fleece is fine, reasonably soft and well crimped. This blend produces a soft but sturdy yarn. It has the elasticity needed for a knitted sweater, it quite soft and has a bit of the halo effect from the qiviut.

Because there is only 25% qiviut in this blend, it cuts down on both the warmth and cost of a pure qiviut yarn. This blend would be good for both inner and outer garments, and is soft enough for baby use. This sample was spun for an outer sweater in mind.
Sample Card 6

80% Corriedale
(Moorit)
20% Qiviut
80% Corriedale (Moorit)
20% Qiviut

Fibre
80% Corriedale (Moorit), 20% Qiviut

Preparation and Spinning Methods
The fibres were blended on the slow intake of a Beverly drum carder using a fur drum. First, each fibre was put through the drum carder separately, weighed and then blended on the drum carder. It was spun worsted style (zzS), 5 tpi at an Aran weight (800 ypp; 2.9’s using worsted wool count system).

This was well blended and well prepared. It was easy to blend and produced a nice, light, fluffy batt. The batt was pulled out into a roving, attenuated and spun. The preparation was very easy to spin.

Dyeing
The blend of moorit Corriedale and natural qiviut takes a dye very well. The colours of these samples are a bit dark as would be expected when overdying a medium shade of brown. The yarn that was dyed light colours, i.e., cochineal and salmon, have a tweed effect.

Knitting
The sample was knit in a Staghorn Cable pattern on 3.75 mm needles.

Discussion of the Blend
The moorit colour of the Corriedale was a natural choice to blend with the qiviut, as the colours are complementary. Corriedale fleece is fine, reasonably soft and well crimped. Blending with qiviut produces a soft sturdy yarn. The blend has elasticity from Corriedale, as well as a soft handle and a bit of the halo from the qiviut. Because this blend has only 20% qiviut, the cost of the yarn would be reasonable. This sample was spun with a chunky sweater in mind.

It would be good for both inner and outer garments and is soft enough for baby use.
I Sample Card 6

- 80% Corriedale (Moorit), 20% Qiviut
- carded on a drum carder using a fur drum
- spun worsted style (ZZS)
Logwood
Cochineal
Salmon
Gold
Red
Turquoise
Sample Card 7

75% Qiviut
25% Bombex Silk
Fibre
75% Natural Qiviut, 25% Bombex Silk

Preparation and Spinning Methods
The length of silk and qiviut fibres are quite different. To better match the length of the qiviut, the silk was cut before blending. The fibres were blended on the slow intake of a Beverly drum carder using a fur drum. First, each fibre was put through the drum carder separately, weighed and then blended on the drum carder. It was spun worsted style (zzS), 6 tpi at a lace weight (3500 ypp; 12.4's using worsted wool count system).

Dyeing
Both silk and qiviut take dye very well. The colours of these samples are dark as would be expected when overdying a medium shade of brown. The yarn that was dyed light colours, *i.e.*, cochineal and salmon, have a tweed effect.

Knitting
The sample was knit in a Feather and Fan lace pattern on 2.75 mm needles.

Discussion of the Blend
This blend of silk and qiviut is a successful combination. The silk imparts a reflective lustre to the yarn, while the qiviut gives the yarn a depth and softness. The qiviut's softness and loft are a very important aspect of the final yarn. This blend has no elasticity. However, because silk does not stretch, garments made from this blend would not either. Because this blend has 75% qiviut, it would still be a quite expensive yarn.

This blend would be good for a scarf, soft shawl or an inner garment such as a cardigan or vest. When spun in a baby, fingering or lace weight, a garment from this blend would be soft and light.
- 4.5 tpi
- 12.4's (worsted wool count)
- lace weight
- 3500 ypp

Level VI, August 2006
Sample Card 8

75% Bombex Silk
25% Qiviut
75% Bombex Silk  
25% Qiviut

Fibre
75% Bombex Silk, 25% Qiviut

Preparation and Spinning Methods
The length of silk and qiviut fibres are quite different. To better match the length of the qiviut, the silk was cut before blending. The fibres were blended on the slow intake of a Beverly drum carder using a fur drum. First, each fibre was put through the drum carder separately, weighed and then blended on the drum carder. It was spun worsted style (zzS), 6 tpi at an sport weight (1500 ypp; 3.5 denier).

Dyeing
Both silk and qiviut take dye very well. When compared to the 75% qiviut/25% bombex silk samples, these dyed samples are a purer and the lighter colours *i.e.*, cochineal and salmon, are shown off better.

Knitting
The sample was knit in Stockinet Stitch on 3.5 mm needles.

Discussion of the Blend
A blend of silk and qiviut seemed to be a natural exotic blend. However, this blend mostly imparts the qualities of silk, and the qiviut qualities seem to be muted when compared to the 75% qiviut/25% tussah silk blend (Sample Card 7). This sample does not have the characteristic softness and loft of qiviut. In addition, blend has no elasticity, however, the silk fibres will likely keep a garment from stretching. The blend would cut down on the warmth of the qiviut as well as the overall cost of the yarn.

This blend would be good for a scarf, shawl or an inner garment such as a cardigan or vest. I was exited about this blend, but after spinning and knitting a swatch, it would not be blend that I would consider repeating. This is because the blend does not have the characteristic soft quality of the qiviut.
- 6 tpi
- 3.5 Denier
- sport weight
- 1500 ypp

Level VI, August 2006
Sample Card 9

45% Qiviut
45% Merino
10% Bombex Silk
Fibre
45% Qiviut, 45% Merino, 10% Bombex Silk

Preparation and Spinning Methods
The length of silk and qiviut fibres are quite different. To better match the length of the qiviut, the silk was cut before blending. The fibres were blended on the slow intake of a Beverly drum carder using a fur drum. First, each fibre was put through the drum carder separately, weighed and then blended on the drum carder. It was spun worsted style (zzS), 5 tpi at a lace weight (3,600 ypp; 12.8’s using worsted wool count system).

The batt was pulled into a roving, which was attenuated and spun. This was a delightful fibre to spin, and it naturally lent itself to a lace weight yarn.

Dyeing
All three fibres in this blend take dye well. Because the natural colour is a medium brown, the dyed samples are a bit dark as would be expected when overdying a light shade of brown. The yarn that was dyed light colours, i.e., cochineal and salmon, have a tweed effect.

Knitting
The sample was knit in a Cockle Shell Pattern on 2.25 mm needles.

Discussion of the Blend
This fibre was blended for a combination of luxury and warmth from the qiviut, lustre and sleekness from the silk and memory and elasticity from the Merino. The qualities of each of the constituent fibres in this blend are imparted into the spun yarn.

Once spinning began, it seemed natural to think of a lacy, lightweight garment. Because this blend has 45% qiviut, it would be important to keep the final garment design light and airy. The Cockle Shell pattern is a good fit with this blend and weight of yarn.

This blend would be good for a scarf, soft shawl or an inner garment such as a cardigan, vest or sweater.
Cockle Shell Lace
Sample Card 10
40% White Polwarth
40% Tussah Silk
20% Bleached Qiviut
40% White Polwarth
40% Tussah Silk
20% Bleached Qiviut

Fibre
40% White Polwarth, 40% Tussah Silk, 20% Bleached Qiviut

Preparation and Spinning Methods
The length of silk and qiviut fibres are quite different. To better match the length of the qiviut, the silk fibres were cut. The fibres were blended on the slow intake of a Beverly drum carder using a fur drum. First, each fibre was put through the drum carder separately, weighed and then blended on the drum carder.

The batt was pulled into a roving, which was attenuated and spun. It was spun worsted style (zzS), 7.5 tpi at a DK weight (1,200 ypp; 4’s using worsted wool count system).

Dyeing
All three fibres in this blend take dye very well. When compared to the 45% natural qiviut, 45% Merino, 10% bombex silk blend (Sample Card 9), the colours of this sample are pure and strong. The pale colours of the logwood and cochineal work well in this fibre blend.

Knitting
The sample was knit in a Fan Lace Panel on 3.00 mm needles.

Discussion of the Blend
This fibre was blended for a combination of luxury and warmth from the qiviut, lustre and sleekness from the silk and softness and elasticity from the Polwarth. The qualities of each of the constituent fibres in this blend are imparted into the spun yarn.

This blend would be good for a scarf, shawl or an inner garment such as a cardigan, vest or sweater. This sample was spun with a cardigan in mind.
Sample Card 10
- 40% Polworth, 40% Tussah Silk, 20% Bleached Qiviut
- carded on a drum carder using a fur drum
- spun worsted style (zzS)
Sample Card 11

80% Black Merino
15% Qiviut
5% Silk Noil
Fibre
80% Black Merino, 15% Qiviut, 5% Silk Noil

Preparation and Spinning Methods
The fibres were blended on the slow intake of a Beverly drum carder using a fur drum. First, the black merino and natural-coloured qiviut fibre was put through the drum carder separately, weighed and then blended on the drum carder. On the last pass, the silk noil was sprinkled over the batt and then the batt was passed through the drum carder once.

The batt was pulled into a roving, which was attenuated and spun. It was spun worsted style (zzS), 5 tpi at an Aran weight (400 ypp; 4’s using worsted wool count system).

Knitting
The sample was knit in Stockinette Stitch on 3.75 mm needles.

Discussion of the Blend
The combination of black and brown fibres in this blend is quite pleasant. The brown colour of the qiviut mutes the dark black of the Merino. The silk noil is a design accent.

This yarn will provide a combination of warmth and elasticity needed for a hardwearing garment. The 80% merino in the blend will cut down on the warmth of the qiviut, provide the much needed memory to the yarn and will result in a yarn that will be able to withstand a wear and abrasion. As well, the cost of the garment would be reduced when compared to a pure qiviut garment.

This blend would be good for a scarf, soft shawl or inner or outer garments such as a cardigan, vest or sweater. It is soft enough for baby use. This sample was spun at a fairly heavy weight with an outer sweater or cardigan in mind.
Sample Card 12

68% Black Alpaca
16% Qiviut
16% Black Merino
68% Black Alpaca
16% Qiviut
16% Black Merino

Fibre
68% Black Alpaca, 16% Qiviut, 16% Black Merino

Preparation and Spinning Methods
The fibres were blended on the slow intake of a Beverly drum carder using a fur drum. First, each fibre was put through the drum carder separately, weighed and then blended on the drum carder. It was spun worsted style (zzS), 5 tpi at an Aran weight (950 ypp; 3.4’s using worsted wool count system).

The batt was pulled into a roving, which was attenuated and spun.

Knitting
The sample was knit in a Lacy Diamond Pattern on 2.75 mm needles.

Discussion of the Blend
The blending of black and brown fibres in combination with the loft of the qiviut invites one to touch the sample. This blend is very soft.

The yarn will have warmth as a result of the qiviut and alpaca. The Merino will provide the necessary memory to a garment made from this blend. Because there is only 16% qiviut in this blend, the cost of the yarn will be reasonable.

This sample was not spun with a project in mind, however because of the softness of the blend, it would lend itself to a design for something that would be next to skin, such as a cowl. This blend would also be good for a scarf, soft shawl, or an inner or outer garment such as a cardigan, vest or sweater. It is soft enough for baby use.
Lacy Diamonds

Fibre
68% l

Prep
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Knit
The s

Disc
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samp

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Sample Card 13

68% Brown Alpaca
16% Corriedale
16% Qiviut
68% Brown Alpaca
16% Corriedale
16% Qiviut

Fibre
68% Brown Alpaca, 16% Corriedale, 16% Qiviut

Preparation and Spinning Methods
The blending was done on the slow intake of a Beverly drum carder. Each constituent fibre was in a different form and required pre-preparation before they were blended. The qiviut was raw, the Corriedale was in roving form and the alpaca was from the fleece. The guard and underhair was picked from the qiviut, and then put through the drum carder once to create a batt. The Corriedale roving was attenuated and put through the drum carder once to create a batt. Finally, the alpaca was combed on mini-combs and drawn into a roving. The three fibres were weighed then put through the drum carder in layers and blended on the drum carder. Three exchanges with the carder was required for blending.

The blended batt was pulled into a roving, which was attenuated and spun. It was spun worsted style (zzS), 4 tpi at a worsted weight (900 ypp; 3.2’s using worsted wool count system).

Dyeing
Both qiviut and alpaca take a dye very well. The natural colour of the blended fibre is a medium dark. As a result, the lighter colours, i.e., salmon, cochineal, logwood, are quite muted. The dark colours strong and overdyed the natural colour of the qiviut and alpaca quite well.

Knitting
The sample was knit in OXO Cable using 3.25 mm needles.

Discussion of the Blend
This blend produces a sturdy yarn that has the softness of all three fibres, the silkiness of the alpaca, and the elasticity and hardwearing characteristics of the Corriedale. The use of only 20% qiviut in this blend cuts down on the warmth of the qiviut. The Corriedale provides the much-needed memory to the yarn and results in a yarn that will be able to withstand a wear and abrasion. The alpaca adds softness to the yarn. As well, the cost of the garment is reduced when compared to a pure qiviut garment.

This blend would be good for almost any type of garment and is soft enough for baby use.
Natural

Logwood

Cochineal

Salmon

Gold

Red

Turquoise
Sample Card 14

66% Yak
34% Qiviut
Fibre
66% Yak, 34% Qiviut

Preparation and Spinning Methods
The fibres were blended on the slow intake of a Beverly drum carder using a fur drum. First, each fibre was put through the drum carder separately, weighed and then the two fibres were blended on the drum carder. The blended batt was pulled into a roving, which was attenuated and spun worsted style (2ZS). Two weights were spun. The yarn used for the knit sample was spun at 5 tpi at a sport weight (1500 ypp; 5.2’s using worsted wool count system). The yarn used for the dyed samples was spun at 5.5 tpi at a lace weight (3000 ypp; 10.5’s using worsted wool count system).

Dyeing
Both qiviut and yak take a dye very well. The blended colour before dying is a light brown. When dyed, the colours can be quite bright. The natural colour of the brown results in a tweedy effect in the lighter coloured samples i.e., the salmon and the gold.

Knitting
The sample was knit in Little Arrowhead Lace using 3.00 mm needles.

Discussion of the Blend
Yak is a soft, fine down fibre with no elasticity. The yak fibre used for this preparation was commercially bleached and appears to be over-processed. The fibre has a dry, dusty feel, and the staple was very short (<2.5 cm or <1 inch). The resulting blend of the yak and qiviut was full of noils. It was difficult to spin a fine even yarn, as is evidenced in the lace weight samples used for dying. The thicker sport weight yarn used for the knit samples was much easier to spin, but still resulted in an uneven yarn.

Regardless of what appeared to be an inferior yak fibre, the resulting blended yarn is soft. However, even though there is almost 35% qiviut in this blend, the yarn does not appear to have the loft characteristic of qiviut, however the loft will likely increase with wear. The qiviut will impart warmth to a garment made from this blend. This blend would be good for a hat, shawl, scarf or vest. Because this blend does not have any elasticity, it would be less appropriate for an outer garment or heavier sweater.
Sample Card 14
- 66% Yak, 34% Qiviut
- carded on a drum carder using a fur drum
- spun worsted style (z.zS)
Sample Card 15

85% Soy Silk,
15% Qiviut
85% Soy Silk
15% Qiviut

Fibre
85% Soy Silk, 15% Qiviut

Preparation and Spinning Methods
The fibres were blended on the slow intake of a Beverly drum carder using a fur drum. First, each fibre was put through the drum carder separately, weighed and then blended on the drum carder. The batt was pulled apart, attenuated and spun worsted style (zzS). Two sample weights were spun. The sample that was knit was spun to 8 tpi at a baby weight (2654 ypp; 17.1 lea). The samples that were dyed were spun to 7 tpi at a DK weight (1134 ypp; 7.6 lea). The linen count was used to measure this sample rather than silk denier because soy silk is not silk but it is a cellulose fibre with a long staple.

Care needs to be taken when blending soy silk and qiviut. Over blending of either of the constituent fibres can result in noils and tangles.

Dyeing
Both soy silk and qiviut take dye very well. The yarn that was dyed light colours, i.e., cochineal, salmon and gold, have a tweed effect. This could have been eliminated with more complete blending.

Knitting
The sample was knit in a light, airy Razor Shell Lace using 2.75 mm needles.

Discussion of the Blend
Soy silk is soft and has a good lustre. When spinning, it tends to fuzz. Like silk, it has no elasticity. A blend of soy silk and qiviut results in an interesting yarn that is light and soft, with a bit of a loft. However, this blend has no elasticity.

A soy silk/qiviut blend would be good for a scarf, shawl or spring top. The blend would cut down on the warmth of the qiviut as well as the overall cost of the yarn.
I Sample Card IS

• 85% Soy Silk, 15% Qiviut
• carded on a drum carder using a fur drum
• spun worsted style (zzS)
Sample Card 16

85% Viscose Rayon, 15% Qiviut
Fibre
85% Viscose Rayon, 15% Qiviut

Preparation and Spinning Methods
The fibres were blended on the slow intake of a Beverly drum carder using a fur drum. First, each fibre was put through the drum carder separately, weighed and then blended on the drum carder. The batt was pulled apart, attenuated and spun worsted style (zzS). The knit samples were spun to 7 tpi at a worsted weight (1040 ypp; 3.7 denier).

Care needs to be taken when blending viscose rayon and qiviut. Over blending of either of the constituent fibres can result in noils and tangles.

The viscose rayon roving had been previously dyed in a natural indigo dye vat.

Knitting
The sample was knit in a Razor Shell Lace pattern on 2.75 mm needles.

Discussion of the Blend
Rayon has a high lustre, is soft and abrasion resistant. This blend of rayon and qiviut has the lustre from the rayon and a bit of loft from the qiviut. The sample feels somewhat like rope, which is likely a function of the spinning rather than the blend. A softer spun yarn would likely not have this harsh feel. However, the yarn in this sample will likely be sturdy and hardwearing and would be appropriate for a warp.

This blend would be good for a scarf, shawl, spring top or lace cardigan.
Razor Shell Lace
Sample Card 17

66% Fox Fibre (Green)
Cotton
15% Qiviut
66% Fox Fibre (Green) Cotton
34% Qiviut

Fibre
66% Fox Fibre (Green) Cotton, 15% Qiviut

Preparation and Spinning Methods
The fibres were blended on the slow intake of a Beverly drum carder using a fur drum. First, each fibre was put through the drum carder separately, weighed and then blended on the drum carder. The batt was pulled apart, attenuated and spun worsted style (zzS). The knit sample was spun to 7.5 tpi at a lace weight (3050 ypp; 7.3’s).

These two fibres blended very easily. The spinning was smooth and even.

Knitting
The sample was knit in a Staggered Eyelets using 2.75 mm needles.

Discussion of the Blend
Cotton and qiviut are not normally fibres that one would think of blending. Cotton is a relatively inelastic fibre with moderate strength and warmth. The muted light green colour resulting from the blend of the natural light green cotton and the light brown qiviut is quite pleasing. The resulting yarn is very soft in both feel and colour. The qiviut lends a bit of a loft to the yarn. The resulting yarn is amazingly soft and drapeable. The yarn was spun softly and will not be hardwearing.

This blend and yarn weight would be good for a scarf, shawl, spring top or lace cardigan. The cotton in the blend would decrease the warmth from the qiviut. Blending qiviut with cotton will cut the cost of the final garment.
Staggered Eyelets

Sample Card 17
- 60% Linen
- 35% Cotton
- 5% Wool

Cut on a drum, with some twist. Not as fine as ordinary linen. 140 yds per oz.
1. The Count System

1.1. Worsted Count (English System)

560 yards/1 pound of fibre is a #1 count

\[
\text{Worsted Count} = \frac{\left(\frac{\text{length in yards}}{\text{weight in grams}}\right) \times 454 \times \text{number of plies}}{560}
\]

1.2. Cotton Count

840 yards/1 pound of fibre is a #1 count

\[
\text{Cotton Count} = \frac{\left(\frac{\text{length in yards}}{\text{weight in grams}}\right) \times 454 \times \text{number of plies}}{840}
\]

1.3. Linen Count

300 yards/1 pound of fibre is 1 lea

\[
\text{Linen Count} = \frac{\left(\frac{\text{length in yards}}{\text{weight in grams}}\right) \times 454 \times \text{number of plies}}{300}
\]

1.4. Silk Count

840 yards/1 pound is 1 denier

\[
\text{Silk Count} = \frac{\left(\frac{\text{length in yards}}{\text{weight in grams}}\right) \times 454 \times \text{number of plies}}{840}
\]

1.5. Yards Per Pound (YPP)

\[
\text{YPP} = \frac{16}{\text{weight of skein in ounces}} \times \text{length of skein in yards}
\]
2. Yarn Guide

Table 1 is a yarn guide which identifies the approximate weight of yarns. This chart is a good starting point, however the category that the yarn fits into has a fairly large range. This yarn chart should be used in conjunction with YPP.

<table>
<thead>
<tr>
<th>Yarn Weight</th>
<th>Yards Per Pound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cobweb</td>
<td>6,000 +</td>
</tr>
<tr>
<td>Lace</td>
<td>3,000 to 6,000</td>
</tr>
<tr>
<td>Baby</td>
<td>2,400 to 3,000</td>
</tr>
<tr>
<td>Fingering</td>
<td>1,800 to 2,400</td>
</tr>
<tr>
<td>Sport</td>
<td>1,300 to 1,800</td>
</tr>
<tr>
<td>DK</td>
<td>1,000 to 1,400</td>
</tr>
<tr>
<td>Worsted</td>
<td>900 to 1,100</td>
</tr>
<tr>
<td>Aran</td>
<td>700 to 1,000</td>
</tr>
<tr>
<td>Bulky</td>
<td>400 to 700</td>
</tr>
<tr>
<td>Very Bulky</td>
<td>300 to 500</td>
</tr>
</tbody>
</table>

Source: adapted from www.prairiewool.com

November, 2006
APPENDIX III

DYE FORMULAE
1. Acid Wash Dyes

The samples were dyed four colours using acid wash dyes (Deka and Ciba). The yarn was weighed and a 2.5% stock solution was prepared for each colour. The colours and depth of shade (DOS) used were:

- salmon – dyed at 5% DOS
- turquoise – dyed at 6% DOS
- gold – dyed at 4% DOS
- red – dyed at 3% DOS

Water was measured out at 40°C. The dye solution, salt and half the vinegar were added. The pot was stirred well, and then the wetted yarn was added. The temperature was raised slowly over 30 minutes to 85°C, stirring regularly. The yarn was removed and the remaining vinegar was added. The yarn was returned to the pot and stirred regularly for the next 15 minutes. The temperature was slowly raised to 98°C and maintained for one hour. The bath was allowed to cool; the yarn was removed and rinsed.

The formula used to determine the amount of stock solution, salt, vinegar and water is found in Table 1.

**Table 1: Formulae for Ingredients in Acid Wash Dyes**

<table>
<thead>
<tr>
<th>Element Required</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5% Stock Solution (ml)</td>
<td>( \left( \frac{DOS\text{ required}}{100} \right) \times weight_of_yarn_in_gm \times \left( \frac{100}{2.5} \right) )</td>
</tr>
<tr>
<td>Salt (gm)</td>
<td>( \left( \frac{15}{100} \right) \times weight_of_yarn_in_gm )</td>
</tr>
<tr>
<td>Vinegar (ml)</td>
<td>( \frac{8 \times weight_of_yarn}{5} )</td>
</tr>
<tr>
<td>Water</td>
<td>40:1 ratio of water to yarn. To convert weight to volume, 1 gm water = 1 ml water.</td>
</tr>
</tbody>
</table>
2. Natural Dyes

2.1. Mordanting

The samples were mordanted with alum and cream of tartar. The alum was weighed to a 10% weight of goods (WOG) and the cream of tartar weighed to 5% WOG then dissolved in a small container of hot water. The mordant pot was filled with water and heated until warm. The dissolved mordant was added, then the warm wetted fibre was added. The mordant bath was brought to 90°C for one hour. The fibre was cooled in the bath and rinsed well.

2.2. Logwood

The logwood samples were dyed at a 200% WOG. The logwood sawdust was weighed to the amount needed, placed in a nylon stocking and soaked in a dyepot of cold water overnight. At the end of the soaking period, the dyebath should be bright purplish red. If it is brownish red, the solution is too acidic and washing soda can be added a teaspoon at a time until the dyebath turns a bright purplish red.

Once the dyepot is satisfactory, it is simmered for one hour, then the dyestuff is removed. The warm wetted yarn is added and simmered for one hour. Once completed, the yarn is removed, cooled and rinsed.

2.3. Cochineal

The cochineal samples were dyed at an 80% WOG. The cochineal was ground very fine and weighed to the amount needed. It was placed in a glass jar, covered with water and allowed to sit overnight. The cochineal solution is added to a dyepot filled with water. The warm, wetted yarn was added and simmered for one hour. Once completed, the yarn is removed, cooled and rinsed.