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Selected Luxury Blends
A Study of Stitch Definition and Handle with a Secondary Focus on Elasticity and Lustre

Master Spinner
Level 6 In-depth Study

Patricia Gillies

Submitted to Olds College April 21, 2017
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Abstract

In her guide to rare and luxury fibres, Judith MacKenzie quotes naturalist John Muir’s observation, “Everyone needs beauty as well as bread” (2015, p. 7). Spinners often satisfy these sometimes conflicting goals by blending luxury fibres with less expensive ones. This in-depth study assesses the benefits, savings and costs of this practice when the added goal is to achieve improved stitch definition.

The study looked at five luxury fibres – angora, bison, camel, cashmere and yak. Each was blended alternatively with cotton, Merino and silk to produce 20 sample skeins and knitted swatches, including control skeins and swatches of the luxury fibres unblended. Effects on stitch definition, handle and lustre were measured through a survey of experienced knitters and spinners; elasticity was measured and calculated; and an online survey of retailers quantified potential cost savings.

The study found that while estimated cost savings are as high as 42%, and while blending fibres can yield sought-after benefits, the characteristics of luxury fibres are often diminished by blending. The spinner’s challenge is to weigh the benefits against the costs and to consider alternatives to blending, such as using luxury yarns as accents.

To reduce variables, the luxury fibres and blends were spun within a narrow range of twists per inch, and all blends were at proportions of 50 per cent. Further studies could identify optimal twist and blending proportions for each luxury fibre.
Introduction

Bison down is gathered from shrubs and fence posts, and combed from the hides of dead animals. The hide from one bison – the largest land mammal in the Americas (MacKenzie, 2015, p. 39) – might yield enough fibre for only 0.5 kilograms of yarn (Robson, Ekarius, 2011, p. 392). Fleece shorn from a typical Merino sheep, by comparison, would average 2.0 to 3.2 kilos after washing (Robson, Ekarius, 2011, p. 140), and one doesn’t have to wait for the sheep to die before harvesting its coat – it produces a new one annually.

Cashmere-producing goats, most of which live in China or Mongolia, each yield only 85 to 113.4 grams of down per year, and usually only until they’re three years old (Rhoades, 2001, p. 52). Meanwhile, the angora rabbit, selectively bred to the point where it could not survive in the wild (MacKenzie, 2015, p. 17), produces as little as 113 grams of fibre annually (Robson, Ekarius, 2011, p. 410) – fibre that for most varieties should be hand plucked.

Bactrian camels, like cashmere-producing goats, are most at home in China and Mongolia. They produce up to 6.8 kilograms of down annually (Robson, Ekarius, 2011, p. 386), which seems significant in comparison to the aforementioned Merino, until one considers that it has to be extracted from the camel’s five coats (MacKenzie, 2015, 33). The yak, native to the Himalayas and as massive as the bison, but at least amenable to
domestication, produces up to 907 grams of down annually (Robson, Ekarius, 2011, p. 419), combed out during the spring moult.

Angora, bison, camel, cashmere and yak are among the animals that provide what are considered luxury fibres. These animals often live in remote locations, or they’re labour intensive to raise, or their fibre needs specialized processing, or they are too dangerous to comb or shear while living. In short, their fibre is more difficult to obtain in significant quantity than sheep’s wool, most North American camelids, cotton and silk.

This rare and luxury fibre also tends to have micron counts that match or are lower than the finest wool, making them among the softest – and most prized – natural fibres available. Over the centuries, for instance, fine cashmere has been sought after by elites from the Roman Empire to India to Europe (Rhoades, 2001, p. 52). MacKenzie notes that Empress Josephine of France had a collection of hundreds of cashmere shawls (2015, p. 49). Demand for luxury fibres, MacKenzie says, is driven by “desire – a deep and driving hunger for the rare, the unusual … and the exquisitely beautiful” (2015, p. 7).

This combination of rarity, demand and soft handle results in the relatively higher cost of luxury fibres. Spinners are often advised to blend luxury fibres with another high-quality fibre to reduce costs, while also capturing some characteristics not available in the luxury fibre. While they are soft, for instance, luxury fibres often lack lustre and elasticity, and they may full to an extent that obscures stitch definition.
This in-depth study looks at the effects on stitch definition, handle, lustre and elasticity from blending each of the five previously mentioned luxury fibres – angora, bison, camel, cashmere and yak – with each of cotton, Merino and silk. Knitted swatches provide visual and tactile illustrations of what is gained and what is lost through blending. Assessments of stitch definition, handle and lustre were made through a survey of 10 knitters and knitter/spinners. Elasticity was measured and calculated by stretching the yarn.

The study is limited to 50 per cent blends, spun within a relatively narrow twist-per-inch range to minimize variables. Further studies could look at the results achieved by varying the blend proportions for a particular luxury fibre and/or at the impact on durability and handle relative to the amount of twist in the yarn.

The report on this study also includes summaries of fibre history and characteristics, based on a literature review. The study did not investigate the implications of blending on dyeing, thus information about propensity for dyeing is not included in Fibre Characteristics subsections.
Materials and Methods

Materials: The Luxury Fibres

Angora

History

The origins of today’s angora rabbits are somewhat obscure. One source says they may have begun as wild rabbits in France (Robson, Ekarius, 2011, p. 404); another credits medieval Turks with selectively breeding a rabbit that would produce an easily shed, long down coat (MacKenzie, 2015, p. 17). The British acquired angora rabbits early in the 18th century, followed within a few years by the French, and then the Germans (MacKenzie, 2015, p. 53-54).

The breeding process resulted in coats that mat too easily for the angora rabbit to survive in the wild (MacKenzie, 2015, p. 17). Additionally, colour was eliminated from the coat through albinism; however, colour has since been reintroduced (MacKenzie, 2015, p. 17).

Fibre Characteristics

Six varieties of angora rabbit produce fibre suitable for spinning; two of these – German and Giant – are commonly grouped together, and one – Jersey Woolies – is so small as to be more novel than practical (Daniels, 2010, p. 64). Angora rabbits produce both guard hairs and down. They are somewhat unique among luxury fibres in that the guard hair is
not removed before spinning for fine yarn, and is instead retained to provide the distinct halo for which angora is prized.

Angora fibre typically ranges in length from one-and-a-half to two-and-three-quarter-inches, with a micron count of eight to 15 for down (Robson, Ekarius, 2011, p. 410). It may have crimp, but it is nevertheless relatively inelastic; it is lightweight and very warm (Robson, Ekarius, 2011, p. 411). Only the Satin angora rabbit has sheen – or lustre (Daniels, 64). Colours include white, grey, reddish and fawn shades; however, the colours are named for the face fur, which tends to be more intense in colour than the body fur (Robson, Ekarius, 2011, p. 411).

Characteristics of each variety include (Daniels, 2010, p. 64-65):

- English – This variety has the fewest guard hairs and is thus the softest of the angora rabbits, but it is also the variety that mats the most easily.
- French – This variety has more guard hairs and thus more halo. It provides a higher fibre yield than the English angora.
- German/Giant – These two varieties generally provide the highest annual fibre yield. They differ from other varieties in that they have three types of fibre, including a secondary guard hair called awl. They grow a dense fibre that must be shorn, not plucked (plucking is the preferred collection method for the other varieties).
- Satin – Translucent guard hairs provide this variety’s characteristic sheen.
Bison

History

Not to be confused with Africa’s Cape buffalo or Asia’s water buffalo, bison came to North America from Europe via Siberia 300,000 years ago (MacKenzie McCuin, 2005, p. 50). The animal – at 905 kilograms, the largest land mammal in North America (MacKenzie, 2015, p. 39) – went on to play a life-sustaining and spiritually significant role for the indigenous residents of the Great Plains and Rocky Mountain foothills (MacKenzie McCuin, 2005, p. 50). There are two varieties – the wood bison in Canada and the plains bison in the United States (Robson, Ekarius, 2011, p. 390).

The bison population was decimated following the arrival of Europeans, plummeting from 70 million to possibly as low as 15,000 (MacKenzie McCuin, 2005, p. 50). It has since crept up to almost 500,000 due to the efforts of conservationists and governments (MacKenzie, 2015, p. 41). It became illegal to shoot bison in Canada in 1889 (MacKenzie, 2015, p. 40) and in Yellowstone Park in the United States in 1894 (Robson, Ekarius, 2011, p. 390).

Fibre Characteristics

Bison have at least five coats: a coarse hair outer coat, medium length coarse hairs, two shorter hair coats and a soft, fine down (Robson, Ekarius, 2011, p. 390), all shed together in a mud-caked mass each spring (MacKenzie McCuin, 2005, p. 52). The down, which is what most spinners seek, has scales and crimp like wool, it has some elasticity, it may or
may not felt, and its ability to absorb water without feeling wet may exceed that of wool (Robson, Ekarius, 2011, p. 392). It comes in grey to reddish brown (Robson, Ekarius, 2001, p. 392).

The staple length of bison down is about one inch, and the diameter averages 18 to 22 microns (Robson, Ekarius, 2011, p. 392). Its hand is said to rival cashmere (MacKenzie McCuin, 2005, p. 51), but it does tend to retain some guard hairs, which have an average diameter of 59 microns (Robson, Ekarius, 2011, p. 392).

**Camel**

**History**

Camel down used by handspinners usually comes from the Asian two-humped Bactrian camel rather than its one-humped, Middle Eastern dromedary cousin (Emerick, 1989, p. 45). Both types of camel evolved from a small animal that lived on the plains of North America 40 to 50 million years ago (Robson, Ekarius, 2011, p. 361). Camels’ ancestors migrated to Asia across the Bering Land Bridge about three million years ago; descendants of those that remained behind became extinct about 10,000 to 15,000 years ago (Robson, Ekarius, 2011, p. 361).

Today, the wild Bactrian is an endangered species. In fact, differences between wild and domestic Bactrian camels indicate that the ancestors of the domestic animal may have already become extinct (Robson, Ekarius, 2011, p. 383).
Domesticated about 3,000 years ago, camels provide food; materials for clothing, shelter, tools and fuel; transportation, and companionship (MacKenzie, 2015, p. 31). Now found in all of Asia, the Bactrian’s original home is in the deserts of northern China and Mongolia, where extreme temperatures contribute to the quality and quantity of down the animals produce (MacKenzie, 2015, p. 32).

**Fibre Characteristics**

Like bison, the Bactrian camel has five coats – two outer coats of hair and three short down coats; of these, the two closest to the skin are used unblended for spinning light yarn, and the third is blended (MacKenzie, 2015, p. 33). The down staple is usually from one- to three-inches long, although it can go up to five inches; baby camel down is finest, at 16 to 18 microns (Robson, Ekarius, 2011, p. 386).

Although baby camel down can be as fine as cashmere, it will not full to the same extent that cashmere will (Robson, Ekarius, 2011, p. 386); it has limited elasticity (Rhoades, 2007, p. 52) and lustre (Robson, Ekarius, 2011, p. 386). Camel comes in shades of light to dark brown, with some grey and white (Robson, Ekarius, 2011, p. 386).

**Cashmere**

**History**

Historically, cashmere came from the Himalayas, from the undercoats of the chiru, a Tibetan antelope, and the changthangi goat (MacKenzie, 2015, p. 50). Sought after by Roman and Indian elite (Rhoades, 2001, p. 52), and used to produce fine yarn for
thousands of years in Asia, cashmere didn’t became popular in Europe until the 18th century, when the British brought shawls back from India’s Kashmir province – there was nothing comparable in Europe (MacKenzie, 2015, p. 48). Initially handspun and handwoven at more than 100 threads per inch, a Kashmir shawl took three years to make. The Jacquard loom, spinning frames and de-hairing equipment – all developed during the Industrial Revolution – were inspired by cashmere (MacKenzie, 2015, p. 49).

Cashmere is now broadly accepted as referring to goat fibre that displays certain characteristics as opposed to the fibre of a particular breed or animal. (The United States, where product labeling legislation specifies that cashmere must come from the capra hircus laniger goat breed, appears to be an exception (MacKenzie, 2015, p. 52).) An estimated 68 types of goat, including Spanish, Boer and angora, may be capable of producing cashmere. Most cashmere comes from China and Mongolia, but also from Iran, Afghanistan, Australia and the United States (Rhoades, 2001, p. 52).

**Fibre Characteristics**

The International Wool Textile Organization, the Cashmere and Camel Manufacturers and the United States government have set 19 microns as the upper limit for average cashmere fibre diameter, with specified deviation and consistency limits (Robson, Ekarius, 2011, p. 348). Other organizations, however, have set even lower diameter limits (Robson, Ekarius, 2011, p. 348).
Goat fibre needs to meet more than diameter requirements, however, to qualify as cashmere. Cashmere’s scales, for instance, are finer than those of wool, even when the wool fibre is similar in diameter (MacKenzie, 1998, p. 70). Additionally, cashmere has “irregular crimp of relatively small magnitude and high frequency” (Rhoades, 2001, p. 54) that contributes to the warmth and airiness of cashmere yarn (Robson, Ekarius, 2011, p. 348).

Various standards have been set for staple length, typically ranging from one-and-a-quarter- to two-and-a-half-inches (Robson, Ekarius, 2011, p. 350). Anything longer tends to draft into a worsted-type preparation, inhibiting the fibre’s characteristic ability to full (MacKenzie, 1998, p. 68).

Cashmere lacks lustre (Meech, n.d., p. 7), and, like other luxury fibres, tends to have less elasticity than wool (Emerick, 1989, p. 34). It comes in white, light to dark brown, and light to medium grey (Robson, Ekarius, 2011, p. 350).

**Yak**

**History**

Yak have lived in Eurasia for two million years. They were first domesticated 10,000 years ago by the Qiang, an ancient people known for taming wild animals; the Qiang were ancestors of Tibetans, Mongolians and Nepalese Sherpas. Wild yak, which at up to 1,100 kilograms outweigh their domestic cousins by 400 kilos, have been classified as
vulnerable. Approximately 14,000 wild yak live on the Qiang-Tibetan Plateau, where they are the largest animal. (MacKenzie, 2015, p. 44, 46.)

Historically, yak have provided food, fuel, shelter and fibre to their owners (MacKenzie, 2015, p. 46-47). They are also used for transportation, as work animals and for sport (Robson, Ekarius, 2011, p. 414). Yak fibre has become commercially available relatively recently due to new de-hairing methods (Robson, Ekarius, 2011, p. 418).

**Fibre Characteristics**

Yak have five coats, including three undercoats that increase in fineness the closer they are to the skin (MacKenzie, 2015, p. 47). The fineness of yak down – the yak undercoat of interest to most handspinners – can vary significantly due to breeding, but even animals not bred for fineness can provide down that’s 18 to 22 microns (Robson, Ekarius, 2011, p. 418). In fact, yak can rival cashmere in fineness, but the fibre is shorter (MacKenzie, 2015, p. 47).

Reports of yak down fibre length vary in sources consulted – from one-inch (MacKenzie, 2015, p. 48) to between one-and-a-quarter- to two-and-a-quarter-inches (Robson, Ekarius, 2011, p. 418). The fibre is soft, lofty and warm, it has irregular crimp and a little elasticity, and it may or may not have lustre; colours include white, dark grey, various shades of brown, gold and black (Robson, Ekarius, 2011, p. 418-419).
Materials: The Blending Fibres

Bombyx Silk Top

History

The discovery of the textile potential of the silkworm cocoon is the stuff of legend; that is, not exactly a matter of historic record. However, literature and physical evidence in China and India date its use to more than 5,000 years ago.

Mulberry silk, from the Bombyx mori silkworm, is thought by some to have been first cultivated in China. Trade in silk between China and England was so important that trade routes through present-day Iran, Iraq, Afghanistan and Turkey became known as the Silk Road. Silk eggs were smuggled out of Asia in the fifth or sixth centuries, and cultivation spread to other parts of Asia and, ultimately, to Europe and the Americas. (Lamb, 2014, p. 8-9.)

Fibre Characteristics

Bombyx silk can have a diameter as low as nine microns. It is white and strong, but not durable, and it is susceptible to damage from chemicals, sunlight, oxygen and heat. It has good elasticity and, thanks to the triangular shape of filaments, superb lustre. Although silk filament is usually 1,000 or more yards long, top is made from waste silk that is cut and combed many times to straighten the preparation and to remove bits of cocoon. (Lamb, 2014, p. 12, 20-22.)
Sea Island Cotton Sliver

History

Gossypium barbadense cultivar, or Sea Island cotton, resulted from cross breeding plants from South America, the Bahamas and Africa in the 19th century (Murray, 2007, p. A5). However, cotton’s origins date back much further and are found on different continents – spinning and weaving with cotton is believed to have taken place as early as 3,000 BC in Pakistan, and cultivation occurred in Mexico in 5,000 BC (Murray, 2007, p. A6).

Arabs were spinning and weaving cotton in the eighth and ninth centuries and were responsible for spreading the practice to Spain. Cotton production began in the New World in the 16th century. A number of inventions during the Industrial Revolution mechanized the processing of cotton in the 18th and 19th centuries. Cotton today is the world’s most common fibre. (Murray, 2007, p. A6-7.)

Fibre Characteristics

The fine-fibred barbadense provides the longest staple length – from one-and-a-half- to two-inches – of the cotton species typically available to handspinners. For comparison, the more commonly grown Hirsutum, or Upland cotton, has a staple length of one- to one-and-a-quarter inches. (Gaustad, 2014, p. 10.)

Cotton fibres are typically as fine as protein fibres such as cashmere and Merino wool. Cotton is soft but strong, and it transfers both heat and moisture away from the body. It is relatively inelastic, and it won’t full. (Gaustad, 2014, p. 11)
Merino Top

History

Merino sheep trace their ancestry to the 11th and 12th centuries and cross breeding by Spanish royalty with sheep imported from a Berber tribe in what is now Morocco. The wool’s fineness was Spain’s competitive advantage in the European wool trade, but trade in the animals themselves was strictly forbidden. In the 18th century, however, some Spanish royalty made gifts of breeding stock to relatives outside the country. By the end of the century, exports to North America began, with 3,500 sheep being sent from Portugal early in the 19th century. (Robson, Ekarius, 2011, p. 135.)

Fibre Characteristics

Merino fibre belongs to the fine wool category, but there’s a broad variety of fineness – from 11.5 to 26 microns, with most falling in the 20- to 22-micron range. The staple length also varies significantly, from two to five inches. Merino has a tight and fine but well-defined crimp; it’s a soft fibre known for its elasticity. (Robson, Ekarius, 2011, p. 135, 140.)

Merino’s fineness and soft hand make it particularly well suited for blending with luxury fibres. It has a moderate lustre that will merge well with the luxury fibres, and it brings elasticity to the blend.
Methods – Fibre Handling

Angora

Fibre must be shorn from the German variety (Daniels, 2010, p. 65) but can be plucked from other varieties; plucked fibre is easier to spin without prep and easier to card (Nankivell Herriott, 1990, p. 57).

Angora matts easily and so should be stored in cardboard (Brown, 1994, p. 72). It is one of the more delicate luxury fibres. Consequently, fibre should be washed after it is spun rather than before (Daniels, 2010, p. 67; Robson, Ekarius, 2011, p. 411). Skeins should be washed gently and dried flat (Rasmussen, 2007, p. C6).

Angora can be spun from the cloud or lightly handcarded with fine-toothed carders into rolags or batt, or spun from the fold if the fibre was shorn and not plucked (Williams, 2016, p. 68). Commercially prepared fibre, such as was used for this in-depth study, is available as top with fibres aligned in a parallel manner. Although it can be spun from top, carding addresses the fibre’s tendency to compress easily.

Several sources recommend spinning angora to a fine grist and with a high twist and low tension (Brown, 1994, p. 72; Daniels, 2010, p. 67; Nankivell Herriott, 1990, p. 58; Spin-Off, 1994, p. 74). One source – Spin-Off, 1994, p. 74 – specifies a twist angle of 20 to 30 degrees. A worsted spinning method is recommended, with the assurance that angora’s sought-after halo will emerge as the yarn is handled (Rasmussen, 2007, p. C6).
Blends of as little angora as 10 per cent (Williams, 2016, p. 69) to 20 per cent (Daniels, 2010, p. 68) will display the fibre’s characteristic halo, according to some spinners. Elsewhere, a 50/50 angora/Merino blend is described as presenting like 100 per cent angora, with even a small amount improving the hand of a “robust” fibre such as Dorset or Shetland (MacKenzie, 2015, p. 55). Longer fibres blended with angora should be cut so there is no more than a 30 per cent difference in fibre length (MacKenzie, 2015, p. 87).

For this in-depth study, swatches and skeins from three blends were produced – 50% angora/50% Sea Island cotton; 50% angora/50% Merino; and 50% angora/50% Bombyx silk. Fibres were blended on fine-toothed handcarders and rolled into punis. During carding, the angora was sandwiched between the fibre it was being blended with. The Merino and silk fibres were cut after the carders were charged, with the cut fibre being reintroduced to the mix. Yarn for a 100% angora swatch and skein was spun from punis, handcarded from commercial top. Yarn for all four skeins and swatches was spun worsted with a backward draw. Swatches are included in the Results section that follows; and the swatch pattern is included in the Appendices.

Bison

Bison fibre is collected from fences, bushes and livestock chutes, and combed from the hides of dead animals (MacKenzie McCuin, 2005, p. 51-52). Producers can also build and mount scratching boxes near drinking and eating areas in an attempt to increase their harvest (Boucher, 2012, p. 17). What they can’t do is gather fibre directly from live...
animals. Although some bison are now kept in captivity, they are notoriously fast and

Bison fibre is de-haired by soaking it in cold water overnight, then in hot soapy water for
about an hour, after which it is rubbed vigourously, and guard hairs are pulled out. The
down is rinsed in hot water. Excess rinse water can be removed (after containing the fibre
in a mesh bag) by the spin cycle in a washing machine or by rolling the fibre in a towel. It
can be dried on a towel or in the dryer on a low setting (MacKenzie McCuin, 2005, p. 53-
54).

Bison can be spun from the cloud, or it can be carded on fine-toothed handcarders and
rolled into punis (MacKenzie McCuin, 2005, p. 54; Robson, Ekarius, 2011, p. 392). The
fibre should be spun woollen due to the short staple length, with moderate twist and light
tension; it should be overplied (MacKenzie McCuin, 2005, p. 55). After spinning, bison
should be fulled (MacKenzie McCuin, 2005, p. 55).

For this in-depth study, swatches and skeins from three blends were produced – 50%
bison/50% Sea Island cotton; 50% bison/50% Merino; and 50% bison/50% Bombyx silk.
Fibres were blended on fine-toothed handcarders and rolled into punis. During carding,
the bison was sandwiched between the fibre it was being blended with. The Merino and
silk fibres were cut after the carders were charged, with the cut fibre being reintroduced
to the mix. Yarn for a 100% bison swatch and skein was spun from punis, handcarded
from producer-supplied down. Yarn for all four skeins and swatches was spun woollen
with a supported long draw. Finishing included fulling. Swatches are included in the Results section that follows; and the swatch pattern is included in the Appendices.

**Camel**

Camel fibre is gathered as all five coats are shed—mixed together—over a six-week period in June and July (MacKenzie, 2015, p. 32). After sorting and de-hairing, camel down is sold either as a cloud or as top after further processing (MacKenzie, 2015, p. 33). If obtained as raw fibre, camel down should be soaked in a mesh bag in warm water for half an hour, then washed as for wool; that is, soaked in hot soapy water and rinsed in similarly hot water, all without agitation. If dried outside, it should be covered with a screen (Rhoades, 2007, p. 52), presumably to keep it from blowing away and/or to keep birds from lining their nests with it.

Camel down can be handcarded or drum carded with fine-toothed equipment. Longer fibres can be combed, but shorter fibres should be carded and rolled into punis. When blending with wool, camel down should be protected inside a sandwich of the fibres with which it is being blended (Emerick, 1989, p. 46). It should be spun with a long draw according to two sources, (Robson, Ekarius, 2011, p. 386; Rhoades, 2007, p. 54), but with a short forward draw according to another (Emerick, 1989, p. 46), and it should be spun fine, with higher than usual twist, light tension and a fast whorl (Emerick, 1989, p. 46-47).
One source recommends finishing the yarn by bringing it to a boil, then allowing it to cool before rinsing it in cold water (Emerick, 1989, p. 47), while another washes the yarn in warm water as for wool (Rhoades, 2007, p. 54).

For this in-depth study, swatches and skeins from three blends were produced — 50% camel down/50% Sea Island cotton; 50% camel down/50% Merino; and 50% camel down/50% Bombyx silk. Fibres were blended on fine-toothed handcarders and rolled into punis. During carding, the camel down was sandwiched between the fibre it was being blended with. The Merino and silk fibres were cut after the carders were charged, with the cut fibre being reintroduced to the mix. Yarn for a 100% camel down swatch and skein was spun from punis, handcarded from commercial top. Yarn for all four skeins and swatches was spun woollen with a supported long draw. It was finished with a moderately hot soapy soak and rinse. Swatches are included in the Results section that follows; and the swatch pattern is included in the Appendices.

Cashmere

Down from goats with cashmere can be combed or plucked in the spring and summer, leaving behind the guard hairs, or it can be sheared and de-haired (Robson, Ekarius, 2011, p. 349). ("Combing is too gentle a word for the actual process," writes Rebecca Mead, "unless you imagine combing the tangled hair of a screaming five-year-old who has just discovered chewing gum") (1999, n.p.).

Although low in grease, cashmere can lose half its weight in cleaning and de-hairing.
Raw cashmere should be soaked in mesh bags in hot, soapy water until the water cools. The process should be repeated until the soak water is clean; the fibre can then be rinsed in warm water, with excess water extracted by spinning or squeezing (MacKenzie, 2015, p. 72-73).

It can be de-haired by folding locks lengthwise, then pulling out the guard hairs, which will not bend; alternatively, guard hairs can be pulled from submerged and compressed down (Meech, n.d., p. 12).

Cashmere can be spun from the cloud, carded or combed (Robson, Ekarius, 2011, p. 350), or handcarded on fine-toothed carders and rolled into punis (Meech, n.d., p. 15). Spinning recommendations vary from a modified long draw or semi-woollen method (MacKenzie, 1998, p. 70) to double-drafting (Emerick, 1989, p. 33) to supported long draw (Meech, n.d., p. 16). Similarly, a range of twist recommendations are offered, including “enough twist to hold and protect the fibers within the yarn” (Robson, Ekarius, 2011, p. 350), moderately high twist (MacKenzie, 1998, p. 70), and a low amount of twist (Meech, n.d., p. 16).

Sources generally recommend spinning with a high ratio and minimal tension to give twist more time to enter the fibre. One source suggests double lacing the flyer to reduce yarn take-up (MacKenzie, 1998, p. 72).
Cashmere yarn should be fulled by soaking it in hot soapy water and agitating it with a sink plunger, rinsing it in cold water, extracting water and smacking skeins on a hard surface (MacKenzie, 1998, p. 72).

For this in-depth study, swatches and skeins from three blends were produced – 50% cashmere/50% Sea Island cotton; 50% cashmere/50% Merino; and 50% cashmere/50% Bombyx silk. Fibres were blended on fine-toothed handcarders and rolled into punis. During carding, the cashmere was sandwiched between the fibre it was being blended with. The Merino and silk fibres were cut after the carders were charged, with the cut fibre being reintroduced to the mix. Yarn for a 100% cashmere swatch and skein was spun from punis, handcarded from commercial top. Swatches are included in the Results section that follows; and the swatch pattern is included in the Appendices.

Yarn for all four skeins and swatches was spun woollen with a supported long draw. It was finished and fulled in the manner described above, although water temperatures and agitation was moderated somewhat for the blended yarns.

Yak

Yak down is usually gathered in the spring by combing the animals when they moult. It is later de-haired. The fibre may be provided as a cloud, carded or combed. (MacKenzie, 2015, p. 47-48.)
Yak down can be spun from a batt or roving, or it can be made into punis on fine-toothed carders. One carding process involves using the centre third of the carders and overlapping two rows of down, staggered vertically. Layering the down between other blending fibre results in a smoother, faster presentation. (Rhoades, 2011, p. 73.) The fibre should be spun with a high ratio and low tension (Rhoades, 2011, p. 74). It should have sufficient twist to “get the strand off the bobbin or spindle, as well as onto it: With some yak fibre … you’ll need more twist than you think” (Robson, Ekarius, 2011, p. 419).

For this in-depth study, swatches and skeins from three blends were produced – 50% yak down/50% Sea Island cotton; 50% yak down/50% Merino; and 50% yak down/50% Bombyx silk. Fibres were blended on fine-toothed handcarders and rolled into punis. During carding, the yak down was sandwiched between the fibre it was being blended with. The Merino and silk fibres were cut after the carders were charged, with the cut fibre being reintroduced to the mix. Yarn for a 100% yak down swatch and skein was spun from punis, handcarded from commercial top. Yarn for all four skeins and swatches was spun woollen with a supported long draw. It was finished in a warm soapy soak and warm water rinse. Swatches are included in the Results section that follows; and the swatch pattern is included in the Appendices.

Bombyx Silk Top

Silk top can be blended by hand by stacking and drafting the silk with another combed fibre. It can also be blended – slowly and in small quantities – on a drum carder, or on fine-toothed handcarders. The silk may be cut to more closely match the fibre it is being
blended with, thus minimizing the tendency of the silk’s shorter fibres to stick together.

Spun silk can be finished by soaking skeins in hot soapy water for an hour or more, then rinsing them in hot water and then snapping the skeins to straighten them. (Lamb, 2014, p. 26-29, 59.)

**Sea Island Cotton Sliver**

Cotton sliver is blended on fine-toothed, clean handcarders. To avoid nepis, it is best carded lightly and on a humid day. “If necessary, you can condition the fibre in a steamy bathroom for an hour or two.” The carded fibre should then be rolled into punis. (Gaustad, 2014, p. 20, 21.)

Cotton should be spun with a light hand, loose tension and high ratio to achieve high twist (Murray, A14). If loosening the tension is insufficient, double lacing the flyer or using a lighter tension cord are among the tactics that reduce take up (Gaustad, 2014, p. 29). Drafting recommendations include point-of-contact, (supported) long draw and double drafting (Murray, 2007, p. A14; Gaustad, 2014, p. 32-33).

**Merino Top**

Merino can be spun from the lock or from combed or carded preparations and is best spun fine (Robson, Ekarius, 2011, p. 140).
**Methods – Results**

**How Results Were Measured**

A questionnaire asked respondents to assess 20 swatches, one for each of the luxury fibres studied and its blends; categories were:

- Eyelet stitch definition
- Cable stitch definition
- Handle
- Lustre

Respondents were asked to rank each of the categories on a 1- to 5-point scale, with 1 being low and 5 being high. Respondents were assured verbally that there were no right or wrong answers. The questionnaire provided definitions of handle and lustre from *The Encyclopedia of Handspinning* by Mable Ross. A copy of the questionnaire is included in the appendices.

Elasticity was measured by stretching a 10-inch sample of each yarn and measuring the maximum length achieved. The difference between the two lengths was calculated as a percentage of the original length.

Twists per inch (TPI), wraps per inch and twist angle were measured via conventional Master Spinner Program methods, using a linen counter, wraps per inch gauge and

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laminated angle gauge. TPI was measured on three separate sections of each yarn and an average calculated.

The fibre cost comparison was made on the basis of a one-day, online survey of costs advertised by several Canadian retailers' websites for fibres similar to those used in this study. The costs recorded in the report are averages of the highest and lowest advertised costs, with the exception of bison, for which only one cost was available.
Results

Results Narrative

Angora

All blends achieved higher stitch definition than 100% angora for both eyelet and cable stitches, with the highest gain for angora/silk eyelet and angora/cotton cable, with 1.0-point and 1.2-points increases respectively. All blends lost handle, with only the angora/silk blend losing less than a full point. Only angora/silk achieved a significant gain in lustre – 1.0 point. All blends gained elasticity, with angora/silk achieving the most significant gain. However, angora’s characteristic halo effect was diminished visibly in all blends. Potential cost savings from blending are estimated at 26.3% to 35.6%.

Potential fields for further study are the effect of the amount of twist on the halo in angora blends and the effect on halo through varying the blend proportions.

Bison

In comparison to 100% bison, stitch definition improved for bison/cotton and bison/silk blends with gains of 1.7 points and 1.9 points for bison/cotton eyelet and cable respectively, and 1.4 points and 1.8 points for bison/silk eyelet and cable respectively. Lustre increased for all blends, particularly for bison/silk, which increased 0.9 point. Elasticity improved slightly for bison/Merino and declined slightly for bison/cotton.
Perhaps the most remarkable finding was a higher rating for handle – albeit marginal – for all blends. Given that luxury fibres characteristically have among the softest handle available, one might expect diminished handle through blending. Of all fibres studied, bison was the only one that was not commercially prepared. An effective de-hairing process may have contributed to less than optimal handle for the bison, leading to improvements through blending.

Potential cost savings through blending are estimated at 29.3% to 37.5%.

Potential fields for further study include investigations into optimal twist per inch and grist for bison and bison blends vis-à-vis durability and handle, a study of optimal proportions for various blends, and a comparison of handle for mill-prepared and producer- or spinner-prepared fibre.

**Camel**

Stitch definition for both eyelet and cable were lower in the camel/Merino blend and higher for other blends in comparison to 100% camel. The most significant changes were for camel/silk eyelet, which was 1.2 points higher than 100% camel, and camel/cotton, which was 0.9 point higher. There were marginal differences in lustre, with even the camel/silk blend, which showed the biggest difference, being only 0.6 point higher than 100% camel. Among all four samples, elasticity was highest in the camel/Merino blend and lowest in the camel/cotton blend. Potential cost savings are estimated at 17.2% to 29.3% through blending.
Potential fields for further study include investigations into optimal twist per inch and
grist for camel and camel blends vis-à-vis durability and handle, and a study of optimal
proportions for various blends.

**Cashmere**

Stitch definition was higher in all blends than in the 100% cashmere sample, with a
corresponding decrease of 0.8 point or less in handle in the blended fibres. Cotton
provided the most significant change to stitch definition, with cashmere/cotton showing
an increase of 1.4 and 0.6 points for eyelet and cable respectively. Elasticity was
maintained in the cashmere/Merino blend but was slightly less in the cashmere/cotton and
cashmere/silk blends. Changes in lustre were negligible. Possibly the higher lustre fibres
such as silk are overwhelmed by cashmere’s robust fulling effect. Potential cost savings
through blending are estimated at 37.9% to 42.7%.

Potential fields for further study include investigations into optimal twist per inch and
grist for cashmere and cashmere blends vis-à-vis durability, handle and propensity for
fulling, and a study of optimal proportions for various blends.

**Yak**

Overall, cotton provided the most stitch enhancement to yak, with the yak/cotton blend
rating 1.8 points and 0.9 point higher than 100% yak for eyelet and cable respectively.
However, Merino matched cotton’s improvement for cable stitch definition and was the
only blending fibre to significantly impact elasticity. Yak/silk’s stitch definition for eyelet
was 1.5 points higher than 100% yak, and silk was the only blending fibre to significantly alter lustre, providing a 1.2-points increase. Potential cost savings achieved through blending are estimated at 16.7% to 28.9%.

Potential fields for further study include investigations into optimal twist per inch and grist for yak and yak blends vis-à-vis durability and handle, and a study of optimal proportions for various blends.
### Results Data

#### Angora and Angora Blends

<table>
<thead>
<tr>
<th></th>
<th>Eyelet Stitch Definition</th>
<th>Cable Stitch Definition</th>
<th>Handle</th>
<th>Lustre</th>
<th>Elasticity</th>
<th>Twist Per Inch</th>
<th>Wraps Per Inch</th>
<th>Twist Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angora</td>
<td>3.2</td>
<td>2.9</td>
<td>4.9</td>
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<td>5%</td>
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<td>20</td>
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<td>5.7</td>
<td>16</td>
<td>20</td>
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<tr>
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<td>5.7</td>
<td>16</td>
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#### Bison and Bison Blends

<table>
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<th>Elasticity</th>
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<th>Wraps Per Inch</th>
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<td>20</td>
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</tr>
<tr>
<td>Bison/Merino</td>
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<td>2.9</td>
<td>1.9</td>
<td>17%</td>
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<td>16</td>
<td>25</td>
</tr>
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#### Camel and Camel Blends

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<th>Handle</th>
<th>Lustre</th>
<th>Elasticity</th>
<th>Twist Per Inch</th>
<th>Wraps Per Inch</th>
<th>Twist Angle</th>
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</thead>
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<td>Camel</td>
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<td>4.1</td>
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<td>15%</td>
<td>5</td>
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<tr>
<td>Camel/Cotton</td>
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<td>4.6</td>
<td>2.7</td>
<td>1.5</td>
<td>10%</td>
<td>5</td>
<td>16</td>
<td>25</td>
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<tr>
<td>Camel/Merino</td>
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<td>3.4</td>
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<td>2.6</td>
<td>14%</td>
<td>5.7</td>
<td>15</td>
<td>25</td>
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#### Cashmere and Cashmere Blends

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<th>Handle</th>
<th>Lustre</th>
<th>Elasticity</th>
<th>Twist Per Inch</th>
<th>Wraps Per Inch</th>
<th>Twist Angle</th>
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<tr>
<td>Cashmere</td>
<td>2.6</td>
<td>3.4</td>
<td>4.7</td>
<td>2.5</td>
<td>20%</td>
<td>5</td>
<td>12</td>
<td>25</td>
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<tr>
<td>Cashmere/Cotton</td>
<td>4</td>
<td>4</td>
<td>3.9</td>
<td>2.9</td>
<td>15%</td>
<td>6.5</td>
<td>16</td>
<td>30</td>
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<tr>
<td>Cashmere/Merino</td>
<td>2.9</td>
<td>3.8</td>
<td>4</td>
<td>2.1</td>
<td>20%</td>
<td>5.2</td>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>Cashmere/Silk</td>
<td>3.7</td>
<td>3.6</td>
<td>4.2</td>
<td>2.7</td>
<td>13%</td>
<td>6.3</td>
<td>14</td>
<td>30</td>
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#### Yak and Yak Blends

<table>
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<th>Lustre</th>
<th>Elasticity</th>
<th>Twist Per Inch</th>
<th>Wraps Per Inch</th>
<th>Twist Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yak</td>
<td>2.2</td>
<td>2.9</td>
<td>3.9</td>
<td>2</td>
<td>14%</td>
<td>5.2</td>
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<td>25</td>
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<tr>
<td>Yak/Cotton</td>
<td>4</td>
<td>3.8</td>
<td>3.9</td>
<td>2.2</td>
<td>13%</td>
<td>6.2</td>
<td>16</td>
<td>30</td>
</tr>
<tr>
<td>Yak/Merino</td>
<td>2.9</td>
<td>3.4</td>
<td>3.8</td>
<td>1.8</td>
<td>17%</td>
<td>6.7</td>
<td>14</td>
<td>30</td>
</tr>
<tr>
<td>Yak/Silk</td>
<td>3.7</td>
<td>3.4</td>
<td>3.4</td>
<td>3.4</td>
<td>13%</td>
<td>5.5</td>
<td>16</td>
<td>25</td>
</tr>
</tbody>
</table>

#### Fibre Cost Comparison - Cost /100g Followed by Cost Savings as Percentage

<table>
<thead>
<tr>
<th></th>
<th>Angora</th>
<th>Angora/Cotton</th>
<th>Angora/Merino</th>
<th>Angora/Silk</th>
<th>Bison</th>
<th>Bison/Cotton</th>
<th>Bison/Merino</th>
<th>Bison/Silk</th>
<th>Camel</th>
<th>Camel/Cotton</th>
<th>Camel/Merino</th>
<th>Camel/Silk</th>
<th>C'mere*</th>
<th>C’mere*/Cotton</th>
<th>C’mere*/Merino</th>
<th>C’mere*/Silk</th>
<th>Yak</th>
<th>Yak/Cotton</th>
<th>Yak/Merino</th>
<th>Yak/Silk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angora</td>
<td>$40</td>
<td>$25.75</td>
<td>$25.50</td>
<td>$29</td>
<td>$22</td>
<td>$28.75</td>
<td>$29.50</td>
<td>$20.25</td>
<td>$24</td>
<td>$17.2%</td>
<td>$11.7%</td>
<td>$8.50</td>
<td>$3.72*</td>
<td>$3.72/Cotton</td>
<td>$3.72/Merino</td>
<td>$3.72/Silk</td>
<td>$20.25</td>
<td>$20.25</td>
<td>$20.25</td>
<td>$20.25</td>
</tr>
<tr>
<td>$40%</td>
<td>35%</td>
<td>35.6%</td>
<td>26.3%</td>
<td>37%</td>
<td>29.3%</td>
<td>29.3%</td>
<td>29.3%</td>
<td>29.3%</td>
<td>17%</td>
<td>17%</td>
<td>17%</td>
<td>17%</td>
<td>17%</td>
<td>17%</td>
<td>17%</td>
<td>17%</td>
<td>17%</td>
<td>17%</td>
<td>17%</td>
<td>17%</td>
</tr>
</tbody>
</table>
| *Cashmere     | **Black

---

- **Elasticity**
- **Twist Per Inch**
- **Wraps Per Inch**
- **Twist Angle**
- **C'mere**
- **C'mere*/Cotton**
- **C'mere*/Merino**
- **C'mere*/Silk**
- **Yak**
- **Yak/Cotton**
- **Yak/Merino**
- **Yak/Silk**
Swatches

Swatch 1
Fibre: 100% Angora  
Fibre prep: Handcarded punis  
Spinning technique: Worsted  
TPI: 5.5  WPI: 20  Angle of twist: 20  
Weight, yardage: 10 yards, 2.5 grams  
Bradford Count: 2/6.5s  
Plies: 2  
Suitable end use: Scarf, cowl  
Spinning and plying direction:

\[
\begin{align*}
&z \\
&\rightarrow s \\
\end{align*}
\]

Swatch 2
Fibre: 50% Angora/50% Sea Island cotton  
Fibre prep: Handcarded punis  
Spinning technique: Worsted  
TPI: 5.7  WPI: 15  Angle of twist: 20  
Weight, yardage: 10 yards, 3.9 grams  
Bradford Count: 2/4.2s  
Plies: 2  
Suitable end use: Scarf, cowl  
Spinning and plying direction:

\[
\begin{align*}
&z \\
&\rightarrow s \\
\end{align*}
\]

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Swatch 3

Fibre: 50% Angora/50% Merino
Fibre prep: Handcarded punis
Spinning technique: Worsted
TPI: 5.7  WPI: 18  Angle of twist: 20
Weight, yardage: 10 yards, 4.2 grams
Bradford Count: 2/3.9s
Plies: 2
Suitable end use: Hat, cowl
Spinning and plying direction:

z

z

Swatch 4

Fibre: 50% Angora/50% Bombyx silk
Fibre prep: Handcarded punis
Spinning technique: Worsted
TPI: 5.7  WPI: 16  Angle of twist: 20
Weight, yardage: 10 yards, 3.8 grams
Bradford Count: 2/4.3s
Plies: 2
Suitable end use: Shawl
Spinning and plying direction:

z

s

z
Swatch 5

Fibre: Bison
Fibre prep: Handcarded punis
Spinning technique: Woollen, supported long draw
TPI: 5.5  WPI: 16  Angle of twist: 20
Weight, yardage: 10 yards, 4.3 grams
Woollen Count (Philadelphia): 2/7s
Plies: 2
Suitable end use: Sweater, vest
Spinning and plying direction:

\[ \text{z} \rightarrow \text{s} \rightarrow \text{z} \]

Swatch 6

Fibre: 50% Bison/50% Sea Island cotton
Fibre prep: Handcarded punis
Spinning technique: Woollen, supported long draw
TPI: 5.8  WPI: 17  Angle of twist: 20
Weight, yardage: 10 yards, 4.1 grams
Woollen Count (Philadelphia): 2/7.4s
Plies: 2
Suitable end use: Sweater, vest
Spinning and plying direction:

\[ \text{z} \rightarrow \text{s} \rightarrow \text{z} \]
Swatch 7

Fibre: 50% Bison/50% Merino
Fibre prep: Handcarded punis
Spinning technique: Woollen, supported long draw
TPI: 5.7  WPI: 13  Angle of twist: 25
Weight, yardage: 10 yards, 6 grams
Woollen Count (Philadelphia): 2/5s
Plies: 2
Suitable end use: Hat, mitts
Spinning and plying direction:

\[\begin{align*}
\text{Z} & \quad \text{S} \\
\text{S} & \quad \text{Z}
\end{align*}\]

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Swatch 8

Fibre: 50% Bison/50% Bombyx silk
Fibre prep: Handcarded punis
Spinning technique: Woollen, supported long draw
TPI: 5.5  WPI: 14  Angle of twist: 25
Weight, yardage: 10 yards, 5.1 grams
Woollen Count (Philadelphia): 2/5.9s
Plies: 2
Suitable end use: Sweater, vest
Spinning and plying direction:

\[\begin{align*}
\text{Z} & \quad \text{S} \\
\text{S} & \quad \text{Z}
\end{align*}\]
Swatch 9
Fibre: Camel
Fibre prep: Handcarded punis
Spinning technique: Woollen, supported long draw
TPI: 5  WPI: 18  Angle of twist: 25
Weight, yardage: 10 yards, 6.9 grams
Woollen Count (Philadelphia): 2/4.4s
Piles: 2
Suitable end use: Sweater, vest
Spinning and plying direction:

Swatch 10
Fibre: 50% Camel/50% Sea Island cotton
Fibre prep: Handcarded punis
Spinning technique: Woollen, supported long draw
TPI: 5  WPI: 16  Angle of twist: 25
Weight, yardage: 10 yards, 4.2 grams
Woollen Count (Philadelphia): 2/7.2s
Piles: 2
Suitable end use: Sweater, vest, shawl
Spinning and plying direction:

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Swatch 11

Fibre: 50% Camel/50% Merino
Fibre prep: Handcarded punis
Spinning technique: Woollen, supported long draw
TPI: 6.3  WPI: 12  Angle of twist: 30
Weight, yardage: 10 yards, 5.7 grams
Woollen Count (Philadelphia): 2/5.3s
Ply: 2
Suitable end use: Hat
Spinning and plying direction: $Z \rightarrow S \rightarrow Z$

Swatch 12

Fibre: 50% Camel/50% Bombyx silk
Fibre prep: Handcarded punis
Spinning technique: Woollen, supported long draw
TPI: 5.7  WPI: 15  Angle of twist: 25
Weight, yardage: 10 yards, 5.2 grams
Woollen Count (Philadelphia): 2/5.8s
Ply: 2
Suitable end use: Shawl, scarf
Spinning and plying direction: $Z \rightarrow S \rightarrow Z$

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Swatch 13

Fibre: Cashmere  
Fibre prep: Handcarded punis  
Spinning technique: Woollen, supported long draw  
TPI: 5  
WPI: 12  
Angle of twist: 25  
Weight, yardage: 10 yards, 3.4 grams  
Woollen Count (Philadelphia): 2/8.9s  
Plies: 2  
Suitable end use: Cowl, hat  
Spinning and plying direction:

Z

s

Z

Swatch 14

Fibre: 50% Cashmere/50% Sea Island cotton  
Fibre prep: Handcarded punis  
Spinning technique: Woollen, supported long draw  
TPI: 6.5  
WPI: 15  
Angle of twist: 30  
Weight, yardage: 10 yards, 4.7 grams  
Woollen Count (Philadelphia): 2/6.4s  
Plies: 2  
Suitable end use: Shawl  
Spinning and plying direction:

Z

s

Z

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Swatch 15
Fibre: 50% Cashmere/50% Merino
Fibre prep: Handcarded punis
Spinning technique: Woollen, supported long draw
TPI: 5.2 WPI: 12 Angle of twist: 30
Weight, yardage: 10 yards, 5.4 grams
Woollen Count (Philadelphia): 2/5.6s
Plies: 2
Suitable end use: Hat, cowl
Spinning and plying direction:

\[ \begin{align*}
&Z \\
&\searrow S \\
&Z
\end{align*} \]

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Swatch 16
Fibre: 50% Cashmere/50% Bombyx silk
Fibre prep: Handcarded punis
Spinning technique: Woollen, supported long draw
TPI: 6.3 WPI: 14 Angle of twist: 30
Weight, yardage: 10 yards, 5.4 grams
Woollen Count (Philadelphia): 2/5.6s
Plies: 2
Suitable end use: Shawl, cowl
Spinning and plying direction:

\[ \begin{align*}
&Z \\
&\searrow S \\
&Z
\end{align*} \]
**Swatch 17**

**Fibre:** Yak  
**Fibre prep:** Handcarded punis  
**Spinning technique:** Woollen, supported long draw  
**TPI:** 5.2  **WPI:** 15  **Angle of twist:** 25  
**Weight, yardage:** 10 yards, 4.9 grams  
**Woollen Count (Philadelphia):** 2/6.2s  
**Plies:** 2  
**Suitable end use:** Sweater, vest  
**Spinning and plying direction:**

```
Z  s  Z
```

---

**Swatch 18**

**Fibre:** 50% Yak/50% Sea Island cotton  
**Fibre prep:** Handcarded punis  
**Spinning technique:** Woollen, supported long draw  
**TPI:** 6.2  **WPI:** 16  **Angle of twist:** 20  
**Weight, yardage:** 10 yards, 4.2 grams  
**Woollen Count (Philadelphia):** 2/7.2s  
**Plies:** 2  
**Suitable end use:** Shawl  
**Spinning and plying direction:**

```
Z  s  Z
```
Swatch 19

Fibre: 50% Yak/50% Merino
Fibre prep: Handcarded punis
Spinning technique: Woollen, supported long draw
TPI: 6.7  WPI: 14  Angle of twist: 30
Weight, yardage: 10 yards, 6.1 grams
Woollen Count (Philadelphia): 2/5s
Plies: 2
Suitable end use: Sweater, hat
Spinning and plying direction:

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Swatch 20

Fibre: 50% Yak/50% Bombyx silk
Fibre prep: Handcarded punis
Spinning technique: Woollen, supported long draw
TPI: 5.5  WPI: 16  Angle of twist: 25
Weight, yardage: 10 yards, 4.2 grams
Woollen Count (Philadelphia): 2/7.2s
Plies: 2
Suitable end use: Cowl, scarf
Spinning and plying direction:
Conclusion

Blending a luxury fibre with another high-quality fibre can reduce costs while also capturing some characteristics not available in the luxury fibre. This study sought to investigate the effects of blending each of five luxury fibres with lower-cost but high-quality fibre on such characteristics as stitch definition, elasticity, handle and lustre, while also assessing the possible extent of the cost savings.

The study found that, generally, blending the luxury fibres with cotton or silk resulted in enhanced stitch definition, but at the expense of handle. (Improved handle ratings for bison blends may have been an anomaly and bear further investigation.) With the exception of some cashmere blends, elasticity typically improved or was at least relatively stable in each of the blended yarns. Blending with Merino generally offered the most significant improvements to elasticity. With the exception of cashmere/Merino and yak/Merino, lustre was higher in swatches made from the blended yarns than in the corresponding luxury swatches, albeit sometimes only marginally.

Spinners blending the luxury fibres with the intent of improving stitch definition need to assess whether the compromised handle is sufficiently offset by the benefits realized. Blending yak with cotton, for instance, improved stitch definition of eyelet and cable by 1.8 and 0.8 points respectively, while reducing handle by 1.2 points and only marginally affecting elasticity and lustre. The cost savings associated with a yak/cotton blend, however, could be close to 30 per
cent, depending on market conditions. Blending cashmere and Merino, meanwhile, made only small changes to stitch definition, lustre and elasticity, and it resulted in a yarn with only slightly diminished handle but with potential cost savings of more than 40 per cent.

Spinners must also assess whether the benefits they seek overwhelm the unique characteristics of the luxury fibre. Blending cashmere and Merino, as noted above, may be tempting economically, but despite the appealing benefits that Merino brings to the mix, it does not fully to the extent that cashmere does. Similarly, data tables suggest many benefits from blending angora – enhanced elasticity is particularly appealing given angora’s typical lack of elasticity – but as noted earlier, the impact of blending on angora’s distinctive halo bears further investigation.

Spinners should be clear on the yarn characteristics they seek in order to assess whether blending will allow them to achieve their goals. It would be false economy to blend to reduce costs if doing so required compromising excessively on the very characteristics the luxury fibre offers. Depending on the effect sought, spinners may sometimes find it more effective to use a luxury fibre as an accent rather than in a blend, or they may find it useful to experiment by blending in various proportions to achieve the results they seek with compromises they’re prepared to make.

In the execution of this study and in the compilation of results, several potential topics for further study emerged. These include:

- Investigations into the effects of varying the amount of twist on handle and durability for each or any of the luxury fibres studied here, in blended and unblended preparations. The literature was generally quite vague on the amount of twist required when spinning the
fibres studied here, and what might seem like an appropriate amount of twist during spinning might later reveal itself to be insufficient or excessive.

- Investigations into the effects of varying the blend proportions for each or any of the luxury fibres studied here, with a view to determining the optimal proportion for particular fibres.
References


Colorado: Interweave.


February 17, 2017.


February 17, 2017.


Colorado: Interweave.


Appendix A

Patricia Gillies
Olds College Master Spinner Certificate
In-depth Study: Luxury Blend Stitch Definition Survey

Spinners are advised to blend exotic or luxury fibres to reduce costs and capture characteristics of the other fibres. This study seeks to explore the suitability of selected luxury blends for lace work and cable work, while at the same time assessing the effects of blending on key yarn characteristics. Two of the key yarn characteristics – handle and lustre – will be evaluated through this survey. The survey also asks for recommendations – on a scale of 1 to 5 – regarding the suitability of each yarn for lace work and cable work, based on stitch definition.

Definitions

Handle – “The sensation given by wool when handled. This can vary from harsh to a velvety softness.” (Ross, 1988, p. 96.)

Lustre – “… the soft sheen which some of the longer wools possess. It is caused by the light reflected from the rather large scales forming the cuticle of these wools.” (Ross, 1988, p. 117.)

Survey

Please give each swatch a 1 to 5 rating on each of the attributes indicated below, with 1 being low and 5 being high.

1. Angora
   a. Eyelet stitch definition
      1 2 3 4 5
   b. Cable stitch definition
      1 2 3 4 5
   c. Handle
      1 2 3 4 5
   d. Lustre
      1 2 3 4 5

2. Angora/cotton
   a. Eyelet stitch definition
      1 2 3 4 5
   b. Cable stitch definition
      1 2 3 4 5
   c. Handle
      1 2 3 4 5
   d. Lustre
      1 2 3 4 5
3. Angora/Merino
   a. Eyelet stitch definition
      1  2  3  4  5
   b. Cable stitch definition
      1  2  3  4  5
   c. Handle
      1  2  3  4  5
   d. Lustre
      1  2  3  4  5

4. Angora/silk
   a. Eyelet stitch definition
      1  2  3  4  5
   b. Cable stitch definition
      1  2  3  4  5
   c. Handle
      1  2  3  4  5
   d. Lustre
      1  2  3  4  5

5. Bison
   a. Eyelet stitch definition
      1  2  3  4  5
   b. Cable stitch definition
      1  2  3  4  5
   c. Handle
      1  2  3  4  5
   d. Lustre
      1  2  3  4  5

6. Bison/cotton
   a. Eyelet stitch definition
      1  2  3  4  5
   b. Cable stitch definition
      1  2  3  4  5
   c. Handle
      1  2  3  4  5
   d. Lustre
      1  2  3  4  5

7. Bison/Merino
   a. Eyelet stitch definition
      1  2  3  4  5
   b. Cable stitch definition
      1  2  3  4  5
   c. Handle
      1  2  3  4  5
   d. Lustre
      1  2  3  4  5

8. Bison/silk
   a. Eyelet stitch definition
      1  2  3  4  5
   b. Cable stitch definition
      1  2  3  4  5
   c. Handle
      1  2  3  4  5
   d. Lustre
      1  2  3  4  5
9. Camel
   a. Eyelet stitch definition
      1  2  3  4  5
   b. Cable stitch definition
      1  2  3  4  5
   c. Handle
      1  2  3  4  5
   d. Lustre
      1  2  3  4  5

10. Camel/cotton
   a. Eyelet stitch definition
      1  2  3  4  5
   b. Cable stitch definition
      1  2  3  4  5
   c. Handle
      1  2  3  4  5
   d. Lustre
      1  2  3  4  5

11. Camel/Merino
   a. Eyelet stitch definition
      1  2  3  4  5
   b. Cable stitch definition
      1  2  3  4  5
   c. Handle
      1  2  3  4  5
   d. Lustre
      1  2  3  4  5

12. Camel/silk
   a. Eyelet stitch definition
      1  2  3  4  5
   b. Cable stitch definition
      1  2  3  4  5
   c. Handle
      1  2  3  4  5
   d. Lustre
      1  2  3  4  5

13. Cashmere
   a. Eyelet stitch definition
      1  2  3  4  5
   b. Cable stitch definition
      1  2  3  4  5
   c. Handle
      1  2  3  4  5
   d. Lustre
      1  2  3  4  5

14. Cashmere/cotton
   a. Eyelet stitch definition
      1  2  3  4  5
   b. Cable stitch definition
      1  2  3  4  5
   c. Handle
      1  2  3  4  5
   d. Lustre
      1  2  3  4  5
15. Cashmere/Merino
   a. Eyelet stitch definition
      1 □ 2 □ 3 □ 4 □ 5 □
   b. Cable stitch definition
      1 □ 2 □ 3 □ 4 □ 5 □
   c. Handle
      1 □ 2 □ 3 □ 4 □ 5 □
   d. Lustre
      1 □ 2 □ 3 □ 4 □ 5 □

16. Cashmere/silk
   a. Eyelet stitch definition
      1 □ 2 □ 3 □ 4 □ 5 □
   b. Cable stitch definition
      1 □ 2 □ 3 □ 4 □ 5 □
   c. Handle
      1 □ 2 □ 3 □ 4 □ 5 □
   d. Lustre
      1 □ 2 □ 3 □ 4 □ 5 □

17. Yak
   a. Eyelet stitch definition
      1 □ 2 □ 3 □ 4 □ 5 □
   b. Cable stitch definition
      1 □ 2 □ 3 □ 4 □ 5 □
   c. Handle
      1 □ 2 □ 3 □ 4 □ 5 □
   d. Lustre
      1 □ 2 □ 3 □ 4 □ 5 □

18. Yak/cotton
   a. Eyelet stitch definition
      1 □ 2 □ 3 □ 4 □ 5 □
   b. Cable stitch definition
      1 □ 2 □ 3 □ 4 □ 5 □
   c. Handle
      1 □ 2 □ 3 □ 4 □ 5 □
   d. Lustre
      1 □ 2 □ 3 □ 4 □ 5 □

19. Yak/Merino
   a. Eyelet stitch definition
      1 □ 2 □ 3 □ 4 □ 5 □
   b. Cable stitch definition
      1 □ 2 □ 3 □ 4 □ 5 □
   c. Handle
      1 □ 2 □ 3 □ 4 □ 5 □
   d. Lustre
      1 □ 2 □ 3 □ 4 □ 5 □

20. Yak/silk
   a. Eyelet stitch definition
      1 □ 2 □ 3 □ 4 □ 5 □
   b. Cable stitch definition
      1 □ 2 □ 3 □ 4 □ 5 □
   c. Handle
      1 □ 2 □ 3 □ 4 □ 5 □
   d. Lustre
      1 □ 2 □ 3 □ 4 □ 5 □
Swatch Pattern

Cast on 23 stitches.
Rows 1 and 2
Knit (K) two rows. (From this point to the last two rows, which are also knit, the first and
last stitches of each row will be knit on both sides of the work, and the second and
penultimate stitches will be knit through the back of the loop on the right side of the work
and purled on the wrong side of the work.)
Row 3
K 1, KTB 1, P 19, K TB 1, K 1.
Row 4
K 1, P 1, K 19, P 1, K 1.
Row 5
K 1, KTB 1, P 9, K 1, P 9, KTB 1, K 1.
Row 6
K 1, P 1, K 9, P 1, K 9, P 1, K 1.
Row 7
K 1, KTB 1, P 8, K 3, P 8, KTB 1, K 1.
Row 8
K 1, P 1, K 8, P 3, K 8, P 1, K 1.
Row 9
K 1, KTB 1, P 8, RLinc 1, K 3, LLinc 1, P 8, KTB 1, K 1.
Row 10
K 1, P 1, K 8, P 5, K 8, P 1, K 1.
Row 11
K 1, KTB 1, P 8, work 5-stitch cable (see Abbreviations below), P 8, KTB 1, K 1.
Row 12
K 1, P 1, K 8, P 2 K 1, P 2, K 8, P 1, K 1.
Row 13
K 1, KTB 1, P 8, K 2, P 1, K 2, P 8, KTB 1, K 1.
Row 14
As for Row 12.
Rows 15 and 16
As for Rows 11 and 12
Rows 17 to 39
Maintain side borders as established and work the two stitches inside each border in
reverse stocking stitch. On the centre 17 stitches, work Rows 4 to 26 for Motif 179 from
The New Knitting Stitch Library (Stanfield, 1998, p. 116). (The motif chart requires that
its even-numbered rows are worked as right-side rows and odd-numbered rows are
worked as wrong-side rows).
Rows 40 to 42
As for Row 10 to 12
Row 43
K 1, KTB 1, P 8, SSK, K 1, K 2 tog, P 8, KTB 1, K 1.
Row 44
As for Row 7.
Rows 45 and 46
As for Rows 5 and 6.
Rows 47 and 48
As for Rows 3 and 4.
Rows 49 and 50
As for Rows 1 and 2.

Abbreviations:
K – Knit.
KTB – Knit through back of loop.
P – Purl.
RLinc – Right-leaning increase.
LLinc – Left-leaning increase.
5-stitch cable – Slip 2 stitches onto a cable needle and hold at front, slip 1 stitch onto another cable needle and hold at back, K 2, P 1 from second cable needle, K 2 from first cable needle.
SSK – Slip one, K 1, slip slipped stitch over knitted stitch.
K 2 tog – Knit 2 together.
Appendix C

Luxury Fibre and Blending Fibre Samples

Angora

Bison

Camel
Appendix D

Sample Skeins

Patricia Gillies
Level 6 In-depth Study
Fibre: 100% Angora
Fibre prep: Handcarded punis
Spinning technique: Worsted
TPI: 5.5  WPI: 20  Angle of twist: 20
Weight, yardage: 10 yards
Bradford Count: 27
Fibre: 50% Cashmere/50% Sea Island cotton
Fibre prep: Hand-carded wens
supported long draw
Jet: 30
Yarns
Patricia Gillies
Level 6 In-depth Study
Fibre: 50% Yak/50% Sea Island cotton
Fibre prep: Handcarded punis

Skein 18

Patricia Gillies, Student ID 000078505
Master Spinners, Level 6 In-depth Study
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Appendix E

IN-DEPTH STUDY PROPOSAL SUBMISSION FORM
(Please refer to the In-Depth Study policy and guidelines before submitting this form)

Name: Patricia Gillies Date: July 16, 2016

Proposed Topic (Objective of the Study):
Illustrate the Suitability of Select Exotic Blends for Knitted Lace and Cable Work

Fibre/s to be used: Cashmere, yak, camel, bison, angora, Bombyx silk, Merino, Sea Island cotton

Preparation method/s: Hand-carded punts from commercial roving/top

Spinning method/s: Supported long draw

Finishing method/s: Wet finish, warm water wash in Dawn, warm water rinse; full where research advises

Samples or end product/s (describe how many and what they will be):

a) 20 knitted swatches, each of which will combine cables and lace stitches; including five sets of four, i.e., one swatch for each exotic fibre and one for each 50/50 blend

b) 20 10-yard skeins, i.e., five sets of four, each including 100% exotic fibre and 50/50 blends with each of silk, Merino and cotton

How will the objective be accomplished (briefly describe what you intend to do):

When working with exotic fibres, spinners are often advised to blend the exotic fibres with less costly fibres. It would be false economy, however, to produce a blend that did not benefit from the best characteristics of each fibre, and that was not suited for the planned use. I intend to produce the skeins and swatches listed in the previous section for evaluation by three persons experienced in the knitting field, e.g., knitting guild member, current designer, retailer. Criteria for evaluation will include hand, stitch definition, elasticity and lustre. In addition to reporting on analysis of the swatches, accompanying narrative will summarize research into recommended techniques for preparing and spinning the exotic fibres and blends and their characteristics. It will also include a review of costs and factors contributing to fibre cost, such as history, hardiness, yield and ease of collection.

Received By: ____________ Approved: ________
Date: ____________ Approved with attached modifications: ________

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MASTER SPINNER
HANDBOOK June 2014

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