Alpaca - Evolution to the Modern Animal

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Alpaca Origins

The alpaca is a member of the camelid family (*Camelidae*). A rabbit-sized ancestor to this family (*Protylopus*) first appeared in the subtropical forests of North America during the Eocene Period (56 to 33.9 million years ago). By 35 million years ago, a goat-sized intermediate form (*Poebrotherium*) had evolved which then diversified into more than 20 genera [1]. The largest of these was *Titanotylopus* which stood an average height of 3.5 metres at the withers and like the modern camels, had a hump for fat storage. At least one genus, including *Hemiauchenia*, spread southwards to reach South America (during the Great American Biotic Interchange) whilst others travelled across the Bering Strait to reach Eurasia. As a result, the guanaco (*Lama guanicoe*) and vicuña (*Vicugna vicugna*) are found in South America whereas the three species of camel (Dromedary, Bactrian and wild Bactrian) are now found in Africa and Asia. In South America, the genera *Lama* and *Vicugna* separated 2–3 million years ago. Human migration from Asia into North America some 12,000 years ago is likely responsible for the extermination of the native camel species although climate change may have also contributed.

The alpaca is the domesticated form of vicuña, achieved by native peoples between 6000 and 7000 years ago in the Peruvian and Bolivian Andes [52]. Due to interbreeding between the the guanaco and vicuña and later decimation of their numbers by the Spanish conquistadores, it was believed that both the llama and alpaca were domesticated forms of the guanaco. However, a genetic analysis [11] has demonstrated that the alpaca (*Lama pacos*) is derived from the vicuña. A very recent paper [25] confirmed this and through sequencing of multiple llama, alpaca, guanaco and vicuña genomes, established the level of genetic transfer (as introgression) between these species. Introgression in the alpaca genome was 36%, far higher than in the llama at 5%. The authors dated this genetic change to the time of the Spanish conquest of the Inca empire between 1532 and 1572, a period marked by (among many other things) a breakdown of traditional management practices.

Clearly, South American camelids can interbreed and produce fertile offspring. A llama crossed with an alpaca produces a Huarizo, a hybrid which shows characteristics from both species. Crossing a vicuña with an alpaca yields a Paco-vicuña, which looks more like the vicuña. This particular cross has attracted commercial interest as 13-17 micron fleece fibres are seemingly attainable over the lifetime of the animal.

Alpacas today

Although distributed over much of South America, 90% of the world's alpaca population is found in Peru at altitudes between 3000 and 4500 metres. South American populations are estimated to be upwards of 350,000 vicuña and 3.5 million alpacas. Although small numbers of animals were brought to Australia and New Zealand during the 1860's, alpaca farming was not successful. It was only during the mid- to late-1980's that export protocols were established between Chile and New Zealand/Australia and many animals were imported. Between 1984 to 1998, alpacas were imported into the U.S. and were issued a pedigree registration by the Alpaca Registry, Inc.. In 1998, this registry was closed to imported animals and thus imports of alpacas into the United States effectively ceased. Exports of large numbers to the UK from Chile began around 1996 and there were subsequent shipments from Peru. There are now significant alpaca populations in South Africa, China and most other European countries. Exact numbers are not available (as only registered animals are counted) but around 35,000 now live in the U.K., 150,000 each in North America and Australia, 70,000 in New Zealand, 2000 in the Netherlands, 1500 in South Africa and many thousands now in China.

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What makes an alpaca?

In New Zealand it is an animal that conforms to the breed standard adopted by the Alpaca Association of New Zealand (AANZ). This standard provides a blueprint for an alpaca in terms of conformation, fleece characteristics, movement and temperament. It exists to protect the species from changes introduced by breeders based on their individual preferences and exclude genetically unsound animals from the breeding pool. Although there is no global breed standard for alpacas, many countries have their own (including New Zealand, Australia, Canada, USA (suri only), whilst others have yet to establish one.

Animals judged to meet the breed standard are eligible for registration in the pedigree database. The AANZ owns a pedigree register which is hosted at the Agricultural Business Research Institute (ABRI). This database holds comprehensive information on all registered animals including the breeder and current owner. It is freely available for public searches but full financial membership of the Association is required to carry out transactions.

A more recent addition to the data set has been DNA certification. Whilst male alpacas are required to have their DNA submitted and recorded as part of the stud certification process, this has been extended to females. The benefit of this process is certainty of any genetic lineage and thus the integrity of the database. All DNA tested alpacas have a 'Parent Verified' symbol displayed alongside their registry entry.

All registered alpacas in New Zealand have brass ear tags which have the origin country "NZ" and the registration number stamped into them. Supplied by the Association, these are frequently attached to the ear by a vet to ensure they are correctly located. By convention, males have the tag attached to the left ear, females to the right.

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Alpaca Types

There are two varieties of alpaca, huacaya and suri. Huacaya alpacas make up over 90% of the global population and are by far the most recognisable type. Their hair grows perpendicular to the body to produce the rounded 'teddy bear' appearance. Suri alpacas have smoother, finer fibres that fall parallel to the body in long well-defined locks.

Although the complete DNA sequence of the alpaca genome is now known and chromosome mapping [10] for gene locations underway, the genetic difference between the suri and huacaya phenotypes has not yet been determined. Using data from controlled matings of suri and huacaya alpacas, a genetic model has been proposed [13] in which the interaction of two unknown but linked genes control the progeny type. Many photographs of huacaya alpacas can be seen on our Gallery page.

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Alpaca Fibre

Alpacas are mainly farmed for their superior fibre for which there is a significant worldwide demand. Huacaya fibre is used for high quality knitted and woven products. Suri fibre has a silky sheen with great visual appeal and has found markets in high end fabrics. Both are essentially free of lanolin and harvested by shearing the animals once per year. The fibre is softer than sheep's wool, hypoallergenic (even for babies) due to smaller and less pronounced fibre scales and has diameters better than most cross-bred wool, similar to merino. The alpaca is adapted to life at high altitude so it is unsurprising that the fibre contains air-filled hollows, improving its thermal insulation properties.

Alpaca fibre can be easily mixed with other natural fibres such as merino, cashmere, mohair, silk and angora to create blends with unique characteristics and adding to market value. As these fibres are all made from keratin protein, they readily take up natural and synthetic dyes. White, light fawn and light grey are the colours most easily dyed.

Peru alone produces 80% of global alpaca fibre at 6,000 tonnes per year (2015). However, alpaca numbers are growing rapidly in other countries (notably China) though it will be many years until there is any significant change to fibre market dynamics.

A system of sixteen fibre colours is recognised by the New Zealand Alpaca Association. Ten range from white through a range of fawn and brown shades through to true black. In addition, there are six grey and rose-grey shades. Other countries have very different colour classification systems.

Reviews of the registered New Zealand huacaya alpaca populations in 2012 [2] and 2015 [19] by the NZ Alpaca Association showed a steady growth in numbers over the three years. Whilst the proportion of white and light fawn fleeced animals (commercially preferred) remained static, the proportion of mid/dark fawns and brown shades had decreased. The difference was made up by significant growth in the grey varieties, presumably a response to customer demand. Given the growth of alpaca ownership in New Zealand, a reevaluation of these numbers seems overdue.

New Zealand Alpaca Population	**2012**	**2015**
Registered animals	17,571	19,461
Fleece Colour	**(%)**	**(%)**
White	30	29
Light fawn	14	14
Mid/dark fawns	17	11
Brown shades	20	16
Black	14	16
Grey shades	5	14

A study [8] into the differences between suri and huacaya fibres showed that huacaya fibre has an ortho and para bicortical cell structure whereas suri fibres consist mostly of paracortical cells. Essentially, the presence of ortho cortical cells causes the fibre to curl and crimp, a desirable trait for breeding.

The range of alpaca fibre colours and the genetic control have yet to be fully explained. Two earlier theories [15], [16] identified two specific genes as responsible. Later work [17] concluded that when these models were validated against Australian alpaca registry data, they did not provide a complete picture. Inaccuracies in breeding records and the failure to recognise fleece patterned areas or skin pigmentation as relevant likely clouded the issue. Recently, an alpaca genetic study was performed [14] into three pigment genes (MC1R, ASIP and Tyrp1), identified as determinants for black, brown and red/yellow pigments in other mammals. The work identified many variants (polymorphisms) of these genes of which six were linked to fibre colour variation, though none from Tyrp1. The absence of this gene being involved in alpaca fibre colour was supported by pigment analysis of fibre samples. Work in this area is progressing with a recent paper [49] reporting the mapping of candidate genes for fiber colour to specific chromosomes. These workers also showed that the locations were the same when comparing camelids and humans or cattle and pigs.

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Alpaca Behaviour

Alpacas are innately calm animals, happy to mill around people and are child safe. Although some animals are more relaxed about it than others, their instinct is not to be touched. Patience and training can overcome this reluctance but progress frequently depends on the character of the alpaca. There is a hierarchy in both male and female herds with a lead animal in each case, generally the oldest and always the most assertive. The 'pecking order' is usually easy to work out.

Alpacas are vocal and make a surprising range of sounds. Most commonly heard is a humming sound which lets other alpacas know they are content. Dams and crias will hum frequently to each other during the first week or two after birth as part of the bonding process and in some cases this may persist much longer. Clucking may indicate friendly or submissive behaviour. A snorting sound marks a warning shot to another herd member, especially when food is involved. Danger is indicated by a loud warbling sound, most often this is triggered by the sight of a dog but domestic cats can also be the cause. Both sexes can scream when fighting but only the males produce a sound known as orgeling during the mating process. Each sound may be accompanied by elements of body language, such as raised or lowered tail, ears forward or down, or particular head and body postures. The combinations of sounds and body language elements make for effective transfer of information amongst the animals. Some of the sounds can be heard below, more will be added as captured:

- Alarm call - 0:00 / 0:05
- Orgeling - 0:00 / 0:08

Alpacas do not spit in the usual sense but splutter air and saliva - completely different from llamas. It is mostly reserved for other alpacas during disputes or asserting authority but occasionally a person can be caught in the 'cross-fire'. Usually one splutter from an alpaca is enough to assert itself but very occasionally there may be a prolonged dispute. Once finished, the bottom lips of the animals will often be hanging down, airing the mouth of the bad taste. Sometimes the animals will mouth and eject leaves to speed the process. When severely angered, an alpaca can regurgitate its rumen contents (a pungent acidic slurry of grass) and project it forcefully at their target. Happily, this is very unusual.

Of all animals kept on a farm, alpacas are perhaps the cleanest as they use communal toilet areas, frequently called ‘middens’. This behaviour is to control the spread of intestinal parasites. These middens must be cleared away regularly; apart from becoming large, they will leach soluble nitrogen into the ground and in wet wether, worm eggs will hatch (for further information, see this section). Grass around the middens will grow very strongly but be avoided by the alpacas as it contains elevated nitrate concentrations and presumably tastes bad. It should be added that males are much better at using middens - the female middens being rather more 'scattered' in a paddock. Due to their efficient digestion which kills most seeds, the dung pellets can be directly applied to gardens or composted.

In a farm setting, it is normal practice to keep males and females in separate paddocks and this includes wethers. Although no longer fertile, wethered males will still exhibit mating behaviours and attempt to mount females. This is not desirable as repeated matings may cause injury to or infections in the females. If paddock space is limited, male crias can be kept with the female herd for up to a year usually without issue but as the typical male behaviours develop, they should be separated.

Alpacas should not share paddocks with other grazers. There may be common elements of body language with alpacas to warn or threaten them but larger or more aggressive species asserting themselves may be dangerous. A kick from a horse or head impact from a sheep or cow is very likely to cause serious injury at minimum. Some alpaca owners are known to keep goats with them without incident. It should be added that several of the common farm species share the same intestinal worm types and do not use middens to contain the spread.

Dogs and cats. These are common animals on farms and lifestyle blocks and deserve separate mention. In New Zealand, dogs are the greatest threat to alpacas though attacks are rare. Most alpacas become used to a farm dog but some never do, sounding the alarm call whenever it is seen. In other countries where native canines (wolf, dingo, coyote) are an issue, alpacas may be bonded with and protected by guardian dogs such as the Maremma Sheepdog. Domestic cats are a source of fascination for most alpacas though may be chased should they run.

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