

# Breed Standards and Bottlenecks

By Eric Hoffman

**I**n the spring of 2006 AOBA encouraged “...all Affiliates to consider organizing and participating in Regional Type Conferences during 2006. For several years now there has been a lot of discussion about Breed Standards. Both the AOBA and ARI Board of Directors recently approved the concept of Regional Type Conferences to educate alpaca breeders about breed standards and to develop a Regional consensus position paper from each participating region describing what should be included in a breed standard for alpacas. These position papers will be taken to a National Type Conference in November 2006 to develop a preliminary alpaca breed standard. That breed standard will then be presented to the entire AOBA membership for a vote on acceptance for its use.” (excerpt from AOBA Affiliate Committee Update e-mail)

In response to this request, breed associations around the country have been holding meetings to educate their members about breed standards and explore the benefits and dangers of adopting an alpaca breed standard. I had the unique experience of being invited to present my views on the topic of breed standards at five regional discussions. The invitations arrived following my article “Some Thoughts on the Push for Breed Standards,” in the March 2006 issue of *Camelid Quarterly*. This was my only written statement on breed standards and the essence of the article is what I reiterated in the regional meetings.

Watching the process after decision-making was interesting. Generally alpaca owners showed a keen desire to understand what a breed standard might mean and how it might affect their alpacas. Morning sessions were dedicated to hearing from invited panelists, who offered different perspectives on issues surrounding the adoption of a breed standard to help members make an informed decision. Alpaca phenotype characteristics, structural soundness and fiber quality were some of the topics covered. These panel discussions were generally amicable exchanges of ideas among the panelists and the audience.

In the afternoon participants commonly met in small groups to formulate their suggestions. In the conferences I attended similar themes seemed to emerge from the discussion of options, though each group expressed them somewhat differently. 1) Some thought no standard at all at this time was the safest bet, 2) Some adopted a go-slow approach by offering up a very minimal standard, 3) Others felt taking charge of the issue and making sure an appointed committee didn't hijack the process later on was the better way. 4) Others endorsed the concept for breed standard for various reasons.

During the course of the meetings, similar concerns and questions kept coming up. Participants wanted to know why they were being asked to decide on a breed standard now. In the initial meetings I attended in Dallas, Texas and Yakima, Washington no one seemed to know who actually wanted a breed standard. The judges on these panels thought they were a good idea, but the question kept being asked: “Who is behind the push for standards?” A July mailing done by an AOBA judge seemed to answer that question for most folks.

## ***Genetic Considerations - An Inconvenient Reality:***

In the meetings held in Dallas and Yakima LaRue Johnson DVM, Jane Wheeler PhD, and I had discussed the nature of breed standards, genetic diseases, bottlenecks and the concerns they raise in relation to creating a breed standard. Using examples from *The Dog and It's Genome* (Cold Spring Harbor Laboratory Press, Inc. New York, 2006) I explained how there are more than 1,050 genetic diseases identified in dogs, and



talked about some of the reasons genetic disease became so prevalent in some breeds (show winning studs who dominated breeding while carrying a lethal trait passed on to offspring, etc.). I also listed more than 70 known congenital defects in alpacas from a list provided by Phillip Sponenberg DVM, PhD.

Jane Wheeler Ph.D. is a Cambridge scholar who is generally recognized around the world as the premier researcher on the evolution of domestic and wild camelids. She and her husband Professor Raul Rosadio run CONOPA, an independently funded camelid research foundation in Peru. When addressing the question of the depletion of the South American alpaca gene pool Dr. Wheeler said, “Domestic camelids survived the initial contact with the Spanish at the time of the Conquest in 1532, but not for long. When I say 90 percent of the alpacas disappeared I always say within 100 years, because in 100 years that is true. At the beginning large herds were registered (for Spanish taxing purposes), but they did not survive.”

In Yakima, La Rue Johnson PhD, DVM, a retired professor from Colorado State University and one of the father's of camelid medicine in the United States, related his view about congenital problems that he thinks may be genetic in nature are present in both llama and alpaca populations. He showed a number of internal defects that aren't commonly seen and emphasized considering carefully the ramifications of putting too much selective pressure on the gene pool.

Several people attending the breed conferences following the July mailing told me that it was their understanding that bottlenecks are no big deal, an over-exaggerated fear at best. They cited Elephant seals and Cheetahs as examples of animals that had been pushed to the very brink of extinction and have rebounded to live on. Unfortunately, the reality is something quite different. If anything, these two species provide a warning to alpaca owners looking at the possible further restriction of the alpaca gene pool. Let me take a moment to explain.

### ***Elephant Seals and Cheetahs***

There are two species of elephant seals, one in each hemisphere. It is true the Northern elephant seals were hunted so aggressively in the nineteenth century that none could be found anywhere. They were feared to be extinct for 30 years before they slowly began reappearing along the California coast where they now exist in seasonal colonies numbering in the thousands.

But, there is more to the elephant seal story than a simple head count. Their flirtation with extinction had an impact on them. The work of Dr. Burney LeBeauf, a retired professor from the University of California and a world authority on

Northern elephant seals explains what happened to their genetic makeup in “They’re Back” in *The Best of Monterey Life*, 1990. “Elephant seals – all 180,000 – have identical genetic make ups. There is no genetic variability, which runs about 10 to 30 percent in most species, providing a margin of safety ensuring that species can adapt to environmental change.” In other words, they survived but they are vulnerable.

What about Cheetahs, the world's fastest land mammal? As a species they have not been robust for quite some time. In fact they are considered “endangered” and listed on Appendix I of C.I.T.E.S. As a comeback-from-the-brink story they can give us little reassurance in terms of genetic soundness and breed health. From the *Smithsonian Conservation and Science* website 2006 we learn that cheetahs have “low genetic variability, abnormal reproductive traits, increased disease risks and poor reproductive success.” Some scientists refer to some wild cheetah populations as relict species, so depleted of genetic diversity they have very few options for improvement.

For whatever reasons, they've bred into a box with few easy exits.



### ***Alpaca Bottlenecks and Hybridization***

Before we sign off on a process that may lead to “breeding into a box”, it is important that breeders understand the history of this species. Breeders should understand how the combination of hybridization and genetic bottlenecks influenced the alpaca gene pool, where and when bottlenecks occurred, and why this might be significant when considering a breed standard.

Alpacas are somewhat unique. They are a domestic species that was essentially created from the vicuna by selective breeding practices and has been maintained by humans. Alpacas never occurred as a wild animal governed entirely by the laws of nature. They can easily hybridize by breeding with closely allied species, the llama and vicuna. The reality of bottlenecks in the population are well documented.

George Miller, PhD., Professor of Anthropology at California State University Hayward specializing in pre-historic Andean cultures, collaborates Dr. Wheeler's observations about the depletion of Incan alpaca herds in an article “Ships of the Andes” that appeared in the California Academy of Sciences publication, “*Pacific Discovery*” in 1989.

“The Spanish brought a kind of zoological imperialism, which altered forever the complexion of the wild and domestic camelid populations throughout the Andes. Spanish horses, mules, sheep, swine and dogs spread across the Andean landscape carrying foreign diseases and competing with the camelids for prime grazing areas. The only survivors were

those in marginal habitats where their evolutionary advantage allowed them to survive.”

Franciscan chronicler Cieza de Leon, who visited Peru shortly after the Conquest, stated: “When the natives hid their flocks, the Spaniards tortured them with cords until they gave (the animals) up. They carried off great droves (of alpacas and llamas) and took them for sale in Lima for next to nothing. The soldiers and citizens took all the Indians’ cloth and were selling it in the square at such low prices that it was sold at half weight. They were killing all the (llamas and alpacas) ‘sheep of the land’ they wanted for no greater need than to make tallow candles. The Indians are left with nothing to plant, and since they have no cattle and can never obtain any, they can not fail to die from hunger.”

If there were a seismic scale for measuring severe genetic upheavals the years following the Conquest would amount to a 10 on the Richter scale. There was a pattern of the Spanish identifying large herds followed by their rapid disappearance, often involving immense regions. This happened over and over again. In the Junin district large herds were recorded shortly after the Conquest 58,672. “Sheep of the land” were paid to the Spanish as taxes between 1533 and 1544. In a report in October 1533 the Urin-Huacana (Inca subgroup) forfeited an incredible 514, 656 animals and later an additional 27,958 to Francisco Pizarro, the head Conquistador. Between 1544 and 1545 a major outbreak of mange “runa simi” was reported to have killed two thirds of the “native sheep” in one of the largest camelid rearing regions. The animals turned over to the Spanish were usually slaughtered for meat to feed the enslaved Indians working in the mines. In 1567 a Spanish chronicler described a herd of 50,000 animals owned by an Indian named Juan Alanacoa. Just five years later his herd was gone. By 1651 the Spanish reports tell that “the sheep of the land” had all but disappeared from Chuquito (today’s prime alpaca growing area near Puno and Juliaca known as the Puna humeda). We will never know what the lowest numbers of domestic camelids was across the immense expanse of the Andes, but around a 90%

reduction is thought to have occurred.

I suppose one could argue this doesn’t constitute a bottleneck when compared to a wild species whose numbers came perilously close to extinction before responding to conservation efforts. But, there are two complicating factors in defining a bottleneck strictly by numbers, 1.) the culture and husbandry practices that maintained the herds collapsed and with it the knowledge of alpaca husbandry 2.) hybridization with llamas occurred as a result of the collapse, so many of the surviving animals were huarizos, not llamas or alpacas.

The Spanish inattention to detail about breeds of animals also muddies the water, Spanish accounts that referred to domestic camelids, usually lumped llamas, alpacas and huarizos into one descriptive term, “sheep of the land.” So attempting to reconstruct which of the domestic species or their hybrids made up the head count on Spanish tax roles is often impossible. A lasting distinction between the domestic South American camelids did not occur in the nomenclature until 1758 when Linneaus finally classified llamas and alpacas as separate species. This classification occurred more than 200 years after the Conquest, further illustrating that any attempt to reconstruct which species (llama or alpaca) the Spanish tax rolls referred to is often impossible. It’s safe to say the herds were decimated, long established husbandry practices vanished, hybridization became rampant and whatever the genetic make up of domestic camelids was before the Conquest, was permanently changed.

#### ***DNA Microsatellites Prove Hybridization***

Recent work by Dr. Wheeler and Peruvian, Argentine and English scientists have shed more light on this turbulent past which may indicate a radical change in the genetic make-up of the camelid herds in the Andes. In 2000 Wheeler and other scientists using DNA microsatellite testing proved that the vicuna was the wild progenitor of the alpaca, which brought about a nomenclature name change from *Lama pacos* to *Vicugna pacos* in 2000. This information coupled with discoveries at the prehispanic archeological site at El Yaral in Peru (dozens of mummified remains of ancient llamas and alpacas) indicates that

selective breeding practices had produced an alpaca superior to today’s animal in terms of low fleece variability and fineness.

And, there is one more bit of interesting information deserving mention. Only 8% of today’s alpaca’s DNA microsatellites tested by Dr. Wheeler and her team were 100% pure to their vicuna ancestry, possibly indicating that the original alpaca of the Andes may be a rare beast, despite the nominal number of 3,000,000 alpacas which is commonly cited in literature as today’s Andean alpaca population. Wheeler, for one, thinks the original alpaca is a rare animal in today’s Andes. The combination of the eradication of the immense herds and the hybridization that followed means a simple census doesn’t adequately describe what occurred.

#### ***A Bottleneck of Our Making: Breeding Trends Indicate a Loss in BioDiversity.***

If you are feeling dismayed by the sordid history affecting domestic camelids i.e., the degradation of a highly refined pre-Hispanic fiber producing animal, there are some facts and trends here in North America that deserve your attention.

In his article “Shaping the Future of the North American Suri Alpaca” which appeared in the Summer issue of *PurelySuri*, Dick Walker, MD makes several important statements regarding the narrowness of the suri gene pool in North America. He points out “Due to genetic drift, the offspring of our imported suris have less genetic diversity than was present in the population from which it was chosen.” Walker states the trend to use a relatively small number of males “reveals a troublesome trend.”

Walker makes use of data he collected from the Alpaca Registry Inc. to reconstruct a bottleneck that occurred due to the Registry closure in 1998 that forbids any new genetic material from entering the gene pool. Walker concludes that 1.4 percent of the 120,000 suris in all of South America actually made it to North America and males (50% of genes in each breeding) made up less than 10% of the imported stock. Highly promoted males were responsible for creating a disproportionately high number of offspring. After presenting the details about the dominant males influencing the overall gene pool Dr. Walker states,

“When so few males account for such a large percentage of production, there should be significant concern among pure Peruvian breeders about the paucity of genetic diversity and the potential for inbreeding depression that could result. If a breeder’s selection criteria are even more restrictive, for example, only Accoyo or only certain colors, then this issue becomes an even greater concern.”

Walker’s call to pay attention to the effects of narrow breeding criteria on the overall population becomes even more imperative when you couple his statistics with the contents of Don Julio Barreda’s “Peruvian Elite Alpaca Sale, Alpaca Selection Seminar”. This document is the translation of a 1994 interview with Don Julio Barreda about his selection practices. The late Don Julio Barreda: “After twelve years, I found out that all progeny had a suri phenotype and that we had a homogenous herd. This made me understand the most important factor in this equation. ‘The father’s lineage.’ The first, second and third sons of the eight initial suris went on impregnating the females in the herd and passing on their characteristic phenotype. None of the mothers we started with were left.”

### **Do Your Own Research**

Anyone wondering about biodiversity in alpacas in North America can access the Alpaca Registry site. In the case of suris, Accoyo suri males dominate the breedings, giving further credence to Walker’s concern about the narrowness of the gene pool. Conversely, if you subscribe to inbreeding and line breeding philosophies there is nothing to worry about. Whatever your philosophy, not only were the original numbers only 1.4 percent of the total population, being impregnated by small number of males, the dominant group among them had been the product of a very restricted gene pool.



When I interviewed Don Julio Barreda in 2001 in Arequipa he mentioned culling animals that were sub par by sending them to slaughter – an option in widespread use when aggressively breeding livestock of any kind to get to a desired level of homogeneity. The option of slaughter is not exercised in North America and animals that are “sub par” often are sold to someone else.

Diversity in huacayas is greater than in suris but by using your registry to check on the production records of well-known males a similar scenario may be unfolding. Three well-known males I looked up accounted for nearly 6000 animals counting both immediate offspring and their progeny. This is nearly 10% of the huacaya population.

Ours is a fledgling industry, and we have only a relatively small percentage of the alpacas living on the planet. Using our DNA based registry to identify recurring anomalies would be as easy as the adoption of a veterinary based reporting system. Investing in research to sleuth suspected genetic problems would also be a step in the direction of insuring the health and diversity of our national herd.

### **Suggested Information Resources**

Readers interested in additional information on the subject of the genetic upheaval that occurred following the conquest and other topics addressed can make use of the publications already cited

and may find these excellent reference materials of interest:

Among the most respected are publications by Jorge Flores Ochoa (*Causas que Originaron la Actual Distribucion Espacial de las Alpacas y Llamas*, (1982) and J.V. Murra. Murra makes distinctions between the early Spanish chroniclers whose reporting was credible and those that weren’t. Murra’s works can be found in the Herds and herders in the Inca State. *In Culture and Animals*, ed A. Leeds and A.P. Vayada, 185-216. Washington: American Association for Advancement of Science Publication 78. Also, *The Vision of the Vanquished* (Barnes and Noble 1977) by Nathan Wachtel, a professor at the Sorbonne, gets high marks from academics. Other works worth retrieving are *Pastores de Puna* (pages 15-52) by Jorge Flore Ochoa (1977), *Una apreciacion etnologica de la vista. Vista hecha a la Provincia de Chucuito por Garci Diez de San Miguel en el ano 1567*, Lima, Casa de la Cultura; Washington (1965); *The Incas and Their Ancestors, the Archaeology of Peru*, (Thames & Hudson) by Michael Mosely (2001,); *The Conquest of the Incas*, pages 641, by John Hemming, Harcourt, Brace and Javonovich (1970). *Informacion etnologica e historica adcional sobre el reino Lupaqa. Historia y Cultura. 4:46-61* (1970); *Formaciones Econmoicas y Polticas del Mundo Andino*, Instituto de Estudios Peruanos, Lima (1975); *La Organizacion Economica del Estado Inca, Siglo Ventiuno*, Mexico (1978); *Alpacas, Sheep and Men: Wool Export Economy and Regional Society of Southern Peru*, pp. 1-270, New York, Academic Press (1977).

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