

AMERICAN CREAM NEWS

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D. Phillip Sponenberg, DVM, PhD, to present a workshop on "Design of Breeding Plans."

D. Phillip Sponenberg, DVM, PhD, of the Department of Biomedical Sciences and Pathology, Virginia-Maryland Regional College of Veterinary Medicine, Blacksburg, Virginia, will present a workshop on "Design of Breeding Plans" at the 1997 annual meeting of the American Cream Draft Horse Association, Saturday, July 12, 1997, at Econo Lodge Motel, 11000 Douglas Avenue, Des Moines, Iowa 50322, (515) 278-4601 at 1:30 P.M.

Phil is requesting that members participating in the workshop bring pedigrees, photos, and experiences to the meeting. It is also suggested that you have blood samples sent to Dr. Gus Cothran for analysis, that you measure your mature animals for height and weight, and be upfront concerning weaknesses and strengths.

The Herdbook is slowly becoming a reality and will be available to Phil prior to the workshop and to members at the workshop.

We are estimating that the total direct expenses of Phil's coming will be \$750.00. He is not charging for his time. It will be necessary for us to provide funds to him so that he may take advantage of early air fare rates. For this reason, we are requiring advance reservations.

Pre-registration for the workshop is \$15.00 per attendee, with the balance to come from the treasury. Reservations will need to be paid to the secretary by **April 1, 1997. The pre-registration form for the workshop appears in this issue of the Cream News.** Arrangements are finalized with the Econo Lodge Motel, 11000 Douglas Avenue, Des Moines, IA 50322, (515) 278-4601 for reservation of ten (10) sleeping rooms for the

nights of July 11 and 12 at \$56.00 (includes tax) per room, per night for up to four persons per room. (Fire code allows no more than 5 persons per room.) Room reservation list is due to Econo Lodge from the secretary June 7, 1997, prepayment with reservation form is by check or credit card number and signature to the secretary by June 1, 1997. This includes the use of the pool and coffee/juice, rolls in the lobby of the motel in the morning. Registration to the secretary guarantees your room after 6:00 P.M. arrival hour. If you find you must cancel before July 10, notify the secretary at (515) 228-5308. If you find you must cancel after that date, phone the Econo Lodge desk before 6:00 P.M. of the day you were to arrive and I will refund your pre-payment.

The meeting room has been reserved for the late afternoon and evening of the 11th as a meeting place for those arriving to visit and become acquainted with others. We will use the same room on the 12th for a 10:00 A.M. meeting. We may bring food from outside the motel into the meeting room—the only RESTRICTION IS THERE IS TO BE NO ALCOHOLIC BEVERAGE—A MOTEL POLICY. The noon lunch will be catered into the meeting room at a cost of \$6.00 per person. The reservation form is in this issue of the Cream News on page 4 if you wish to mail all forms and money at the same time; however, it is not due until June 1, 1997. ■

From the American Livestock Breeds Conservancy News, May-June, 1993, Volume 10, Issue 3. Reprinted with permission.

Blood Typing and Genetic Conservation

By E. Gus Cothran

Dr. E. Gus Cothran is Director of the Equine Blood Typing Research Lab at the Department of Veterinary Science at the University of Kentucky. This paper was presented at the 1991 ALBC annual meeting.

My subject is genetic management and conservation based upon information obtained by what is termed blood typing. But first, I need to tell you exactly what blood typing is.

When most people think of a blood type they think of their own. A type such as O+ is giving information about two genes, the ABO blood group and Rh blood group. The ABO gene has three forms: A, B and O. Individuals have two copies of each gene, one from their mother and one from their father. For the ABO system, a type of O means both genes are the O form. A type of A could be either two copies of the A form or an A and an O. This is because the A form is dominant and the O form is recessive. The B form is also dominant to O so type B could be either two Bs or B and O. Type AB is just that. The Rh system is similar but with only two forms of the gene, + or -, with + dominant to -.

Blood Typing of the Horse

When we talk of a horse's blood type we are talking about more than two genes. At the University of Kentucky we routinely type 17 different genes. Seven of these genes are for blood group systems similar to human ABO and Rh blood groups. The horse blood groups are named A, C, D, K, P, Q, and U. The number of different forms (or variants) of these genes that we recognize at the University of Kentucky ranges from 2 to 18.

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Blood Typing, *con't*

The other 10 systems are what are termed biochemical polymorphisms that are found in blood serum and within red blood cells. These genes are albumin, A1B glycoprotein, esterase, glucosephosphate isomerase, hemoglobin, phosphoglucomutase, phosphogluconate dehydrogenase, protease inhibitor, transferrin, and vitamin D binding protein. The number of variants at these systems range from 2 to 24.

We do not actually examine the genes but look at gene products or proteins. The proteins of the blood group genes occur as part of the surface membrane of red blood cells. These proteins are detected by making antibodies that will react with these proteins and cause blood cells that have the protein to either burst or stick to other such cells. The presence or absence of the various proteins that comprise the variants of the blood group genes are detected by exposing blood cells to antibodies specifically produced to react with these proteins. These techniques are known as serology.

The biochemical polymorphisms are proteins that are present in blood serum or within red blood cells. These proteins are detected by a process called electrophoresis. In this process, proteins are exposed to an electric current which causes them to move through a support medium called a gel. Genetically different forms of a protein will move at slightly different rates and when the gel is stained these differences can be visualized and recorded.

A blood sample, once it is received at the lab, is subjected to a battery of serological and electrophoretic tests to determine an individual's genetic makeup at these 17 genetic systems. This is the blood type. The various forms of the genes at each genetic system are also called genetic markers. Blood typing is more correctly described as gene market typing.

Uses of Genetic Type

Now that we have the genetic type what do we do with it? One thing we can do is look at the genetic relationship of the breed we are examining with other breeds. Because these markers are genetic, they provide information about ancestry. For such analyses, the frequency of each marker in the breed is calculated and compared to the marker fre-

quencies of other breeds using statistics designed for such purposes. These analyses can tell you which breeds (of those that you have data for) are most genetically similar to your breed. Also, ancestor-descendent relationships of the breeds in the analysis can be estimated. Such analyses may provide information that can be used for understanding the history of the breed of interest.

However, for the most part we are interested in the status of rare breeds and for this we employ other genetic measures.

The primary measure we obtain from an individual type is termed heterozygosity. Heterozygous means that the two copies of a

Genetic variability is directly related to population size. Finite populations will lose genetic variation through a process called genetic drift, and the rate of loss is directly related to population size. The key term is effective population size, a complex term which essentially is the number of individuals that produce the next generation. It is often much less than the total number of animals in the population.

The rate of loss of genetic variation in finite populations is the inverse of 4 times the effective population size per generation. So if you have an effective population size of 1,000, then the rate of loss is 0.025% per generation;

but if effective population size is 10 (not unrealistic for some very rare breeds) the rate of loss is 2.5% per generation. This loss of genetic variation in small populations is the primary concern with rare breeds and genetic conservation aims to minimize this loss.

Breed Evaluation

Horses, as a species, have remarkably high levels of variability. But how do rare breeds compare to the major breeds? I define rare breeds by their inclusion in the priority list of the AMBC or by personal knowledge that population size of the breed is small. Table 1 shows two measures of genetic variation for several "major" breeds. The first measure is effective number of alleles. This is a measure of the average number of genetic variants at a gene marker system in a breed, which takes into account both the number of variants and the frequency of the variants in the breed.

As you can see, the values of the effective number of alleles ranges from 1.84 in Thoroughbreds to 2.69 in the Chilean Criollo. In general, the effective number of alleles is lower in the older breeds that have maintained a closed stud for longer periods.

A similar pattern is seen for mean effective heterozygosity. This measure is the expected average proportion of systems heterozygous per individual across the 17 systems for the breed, based upon a genetic principle termed the Hardy-Weinberg Law. Again, the low value is for the Thoroughbred while the highest value, about 49%, is for the Miniature horse.

Even for numerically large breeds, variability is lost over time in closed stud books—

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Table 1
GENETIC VARIABILITY MEASURES FOR
SELECTED MAJOR AND RARE BREEDS OF HORSES

Major Breed	Mean Effective #Variants	Mean Effective Heterozygosity
Thoroughbred	1.84*	0.319*
Quarter Horse	2.57	0.439
Standardbred	2.03	0.415
Arabian	2.03	0.393
Saddlebred	2.35	0.432
Miniature	2.56	0.488**
Andalusian	2.35	0.428
Chilean Criollo	2.69**	0.449
Paso Fino	2.43	0.440
Mean	2.32	0.423
Rare Breed	Mean Effective # Variants	Mean Effective Heterozygosity
Rocky Mountain	2.38	0.432
Caspian	2.06	0.403
Blue Star Arab	1.68	0.270*
Akhal Teke	1.90	0.380
American Cream Draft	2.25	0.451
Suffolk Punch	2.26	0.459**
Gotland	2.07	0.401
Exmoor	2.17	0.457
Friesian	1.65*	0.315
Belgian Draft	2.49**	0.452
Mean	2.09	0.402

* low value
** high value

gene that an individual has inherited (one from each parent) are different forms of the gene. If the two copies are the same the term is homozygous.

Heterozygosity is a measure of genetic variability and can be considered at the level of the gene, the individual or the breed. Genetic variability is, in effect, a measure of genetic health. For the individual, low heterozygosity might indicate inbreeding, while at the level of the breed, long term adaptability or ability to respond to selection are related to genetic diversity.

So what does this mean for rare breeds?

The following is a News Release from the College of Veterinary Medicine, Michigan State University, December 19, 1996. Reprinted with permission.

Winter Dehydration in Horses

It's a little known fact that horses can actually be thirstier in the winter than they are in the summer. "During cold weather, especially if the humidity is high, a horse's thirst mechanism does not always function as efficiently as it does in the summer," said Ken Gallagher, a Michigan State University College of Veterinary Medicine Extension equine veterinarian. Some water is lost from a horse's body every day through the urine, feces and moisture in breath exhaled from the lungs. If the horse is performing during cold weather, significant water can also be lost from sweating.

Dehydration occurs if a horse loses too much water from its body and does not replenish it, or if a horse just is not consuming enough water every day to meet its bodily needs. A three to four percent loss of body water will cause mild dehydration. Some horses will only drink five to six gallons of water per day, eat normally and remain healthy. "These horses are the exception; their kidneys have the ability to concentrate urine and recycle more of the water back into the body," said Gallagher. Most horses are not capable of this kind of kidney function and should be provided adequate, good quality water. Most adult horses weighing 1,000 lbs require a minimum of 10 to 12 gallons of water each day for their basic physiological needs. Good-quality water must be free of harmful germs, foreign material, excessive minerals, environmental pollutants and unusual flavors. Occasionally, horses will eat snow if it is available and cut back on drinking water somewhat. "Horseowners should not depend on snow as a water source and should provide an adequate water supply," he said.

Regardless of season and weather conditions, horses should have water every day in plentiful supply. It is the most important nutrient, because it is needed for almost every bodily function: it helps to maintain appetite and proper moisture level in feed and feces, maintains normal blood volume and aids in the normal function of sweat glands.

There are two common complications resulting from inadequate water consumption during cold weather. The first is decreased feed intake. "Even if good-quality feed is offered, the horse will cut back on consumption if it is not drinking sufficient water," said Gallagher. One reason for this is the lack of saliva to mix with the feed as it is being chewed. A normal adult horse in a state of good hydration will secrete up to 10

gallons of saliva per day to help soften the food mass as it is chewed and swallowed. If the appetite is affected and less feed is consumed, the horse might not receive enough energy to tolerate the cold weather, he said.

The second, and potentially more harmful complication, is impaction colic or constipation. Both the feed material during digestion and the fecal contents after digestion must maintain adequate moisture levels or they can cause a blockage in the intestinal tract. A horse will not become impacted in one day from decreased water consumption. The process usually happens over several days to several weeks. "If the horse becomes chronically dehydrated over a period of time, the body reserves are lowered and a blockage can occur," said Gallagher. The usual signs of an impending impaction colic are depression, decreased appetite and decreased production of manure that is drier than normal. If these signs are observed, a veterinarian should be called. Early detection usually means the colic can often be resolved without requiring surgery.

Always provide adequate, good-quality water, preferably on a free-choice basis. If horses are given access to a tank or automatic waterer, consumption cannot be determined accurately. Owners should watch for signs that these horses are not eating well or becoming lethargic. If horses are watered from pails, either by hand or in a stall, be aware the stomach capacity of a 1,000-pound adult horse is only five to six gallons, so it is difficult for them to drink more than that amount at one time. Two waterings per day will provide only the minimum amount of water needed. Under those conditions, a horse should have an opportunity to drink more frequently, especially if the horse is performing. Previously, it was thought the best water temperature for horses was from 45 to 65 degrees, and if the water got colder, many horses would decrease consumption. This was especially true of horses 12 years of age or older whose teeth are sometimes more sensitive to cold water. A recent study of water consumption by ponies during cold weather indicated warming the water well above freezing temperature resulted in approximately 40 percent more water consumed per day. It probably is not necessary to increase the water temperature a great deal for every horse, Gallagher said, but it would be worthwhile if consumption is below normal or if a horse has a tendency to get impacted.

Increasing salt intake might also stimulate a horse to drink more. The idle, adult, 1000-pound horse should be consuming about two ounces of salt per day. If salt has been added in a commercial grain mix, an owner can offer the horse an additional handful of loose salt in the grain box or provide a salt block.■

The following is a News Release from the College of Veterinary Medicine, Michigan State University, December 19, 1996. Reprinted with permission.

Winter Energy Needs in Horses

Feeding horses during the winter season is a task with two goals: to sustain and nourish the animal's body and to keep it warm. In the winter, just as in any season of the year, the horse needs a combination of nutrients such as carbohydrates, fat, protein, vitamins, minerals and water to remain healthy. "During cold weather, feed energy and the resulting body heat generated are very important for the horse's health and survival," said Ken Gallagher, a Michigan State University College of Veterinary Medicine equine Extension veterinarian.

Horses use feed energy produced from nutrients in their rations. Each cell in the horse's body needs a certain amount of energy on a daily basis in order to live and function. "The only exceptions are the cells found in the hair, hoof wall and parts of the teeth," said Gallagher. The most common nutrient used for energy is carbohydrates, followed by fat, then protein. Protein is not ideal as an energy source, but it is used for that purpose, especially if the horse is not consuming enough carbohydrates or fat. "A 1,000-pound, idle, adult horse will need approximately 20 to 25 pounds of total feed per day during the winter," said Gallagher. "Eighty to 90 percent of the total nutrients needed will contribute to body energy demands."

Body condition is partly a function of maintaining a layer of fat under the skin. When the horse is carrying a long haircoat, it is difficult to determine the level of condition. Horse owners who are not experienced in palpating (touching) the rib and back areas of the horse to check for body condition should contact their veterinarian to do a physical examination.

The secondary goal during the winter is to provide adequate nutrition to allow the horse to generate enough body heat to remain comfortable. "Horses will naturally grow a longer coat for insulation in response to cold temperatures, but they still need good body condition, a small layer of fat under the skin and adequate body heat to tolerate cold temperatures," Gallagher said. Feeds vary in their caloric content, and just as importantly they vary in the amount of heat the horse can generate from them during the winter. "It is not predictable exactly how much body heat each horse can generate from a feed or combination of feeds because of the individual variations in metabolism," said Gallagher.

Contrary to some myths, corn is not a "heating feed." It provides less body heat than oats—even though corn has more digestible energy. This is because corn has a much lower fiber content than oats. Research has shown that even though roughage (hay) is lower in digestible energy than grains, it will allow the horse to generate more body heat. A higher percentage of energy is given off as heat from good-quality hay compared to grain because of the way roughages are processed by the intestinal system. Roughages are digested by microbial fermentation in the large intestine of the horse, and this process generates greater amounts of heat. Good-quality roughages should be the foundation of any equine ration, regardless of the season. Along with trace mineralized salt and water, good-quality roughages—such as an alfalfa and grass mix—can make up most or sometimes all of the ration for an idle adult horse during the winter.

Feeding concentrates is necessary only when the horse cannot maintain proper body condition. Gallagher outlined several alternatives to consider when body condition is not being maintained. "The most reasonable approach is to provide extra good-quality hay in rations," he said. Feed 5 to 10 pounds more hay each day for several weeks and see if that improves body condition. An idle horse is physically able to eat approximately 3 percent of bodyweight or 30 pounds per day for a 1,000-pound horse in a day. If the horse does not consume enough hay, then grain can be added. Start the horse out slowly on grain and allow it to adjust over a two-week period. It should not require more than 5 to 6 pounds of grain per day.

Another alternative that allows feeding a higher proportion of roughage and a smaller amount of concentrate is to feed a commercial grain mixture with additional fat added. Fat is much more energy-dense than grain. This type of concentrate would have higher digestible energy with less volume. Total added fat should not exceed 10 percent of the total ration. Several factors should be taken into consideration if the horse cannot maintain proper body condition, according to Gallagher. Is the horse drinking adequate water of good-quality? A 1,000-pound, idle, adult horse should be consuming at least 10 to 12 gallons per day. If it is not consuming adequate water, it will decrease total feed eaten.

Good dental care is necessary for a horse to chew properly and use feed efficiently. Teeth should be examined by a veterinarian if body condition is not maintained.

Internal parasite control is necessary for any horse. If horses are appropriately treated for parasites four times per year, this should not be a factor. ■

Blood Typing, *con't*

that is, breeds that do not allow breedings with individuals from outside the breed. The Thoroughbred is the perfect example. The Thoroughbred is probably the largest breed, in terms of numbers, worldwide. Yet Thoroughbreds have the lowest genetic variability of any "major" horse breed. I suspect this is because the Thoroughbred has had a closed stud for over 200 years. As well, in the early years the population size was not nearly so large. Whether this low variation has had an effect upon the breed is subject to debate.

The 10 rare breeds I've chosen to show have lower variation overall. The effective number of alleles ranges from 1.65 for the Friesian to 2.49 for the Belgian. Heterozygosity ranges from 27% for the Blue Star Arab to 46% for the Suffolk. The mean values are noticeably lower. However, note that the mean heterozygosity of the rare breeds is only 2% lower than that of the major breeds. For the Exmoor, an ancient breed with low population size, the heterozygosity is higher than all but one of the major breeds.

Does this mean that we can be free from worry regarding genetic variation within rare breeds? The answer is absolutely not.

First, look at the effective number of alleles. Although the means differ by only about 2 tenths of a variant. Half the breeds have only about 2 variants per locus (average). Obviously, a reduced number of variants means reduced variability regardless of heterozygosity. As well, a loss of variants represents a loss of the unique genetic characteristics of a breed, which is to a large degree what we are trying to preserve. Also, consider that the very low Thoroughbred

figure does lower the major breed average.

How do we manage rare breeds to minimize loss of genetic variability? As I mentioned before, population size is the key parameter in rate of loss of genetic variation, but even large populations will lose variation if they are not managed. As well, economic considerations show that few rare breeds will have the opportunity to obtain large population size.

There is another important consideration—inbreeding. Inbreeding is mating among related individuals and is unavoidable in small populations. Inbreeding reduces heterozygosity and can potentially cause reduced fertility and viability. This is known as inbreeding depression. So we have two related problems—inbreeding depression and loss of genetic variation.

But these problems can be managed. The most important step is to make even the contribution of the genetic "founders" of the breed. By founders I don't mean breed ancestors (like the Godolphin Arabian) but the individuals that define the sire and dam lines that still exist within the breed. Often, from a practical standpoint, it simply means the individuals in the pedigree that have unknown parents. Doing this maximizes the genetic diversity initially present in the breed and maximizes effective population size and thereby minimizes the rate at which genetic variation is lost.

It is also important to try to eliminate inbreeding depression. To a large extent, inbreeding depression is a result of deleterious recessive forms of a gene being inherited from both parents. Every individual carries such deleterious genes but because they also have the non-deleterious form of the gene, they show no reduced "fitness." Ideally, the

plan would be to breed the most inbred individuals that were clearly healthy and to cull individuals that show reproductive problems or clearly reduced viability. This process can potentially eliminate the deleterious genes from the breed and thereby eliminate inbreeding depression.

So the overall strategy would involve the following two steps. Maximize the genetic contribution of all the "founders" of the current population. Intentionally inbreed but use only those individuals that show the least adverse effect from inbreeding. If possible, the population size should be increased at the early stages of this process to minimize the reduction in population numbers associated with selection against those individuals showing inbreeding depression.

During this process, genetic market typing can be used to monitor genetic variability within the breed. Both heterozygosity and specific variants can be monitored. Also, pedigree analyses can be used to track founder contributors to the current population and the risks of loss of the genetic contributions of specific founders. Pedigree analyses are perhaps more important in terms of decisions regarding which animals to breed, but market typing can give a measure of how well the scheme is working.

Obviously, the above management strategy is quite difficult when the owners of the horses are widely dispersed, have different goals for their breeding operations, and have different financial situations. This strategy can work even if all breeders are not involved as long as most major foundation lines are represented. My impression is that for most rare breeds, the people involved put the breed first so that maximal preservation is possible. ■

Creams in the News

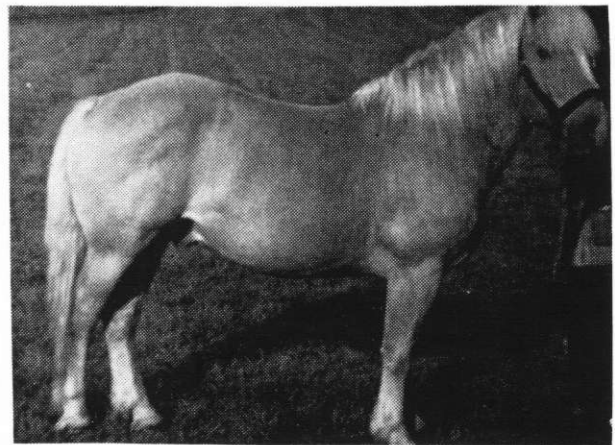
The Brighton Argus, Wednesday, May 1, 1996
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Karen V. Smith, *Editor*
Deanne Bailey, *Production*



For Sale

Stallion, 9 yrs., pink skin, dark cream, white mane and tail, amber eyes, blaze and four white socks. \$3,500.00. Contact Jack Ackerman, 16940 S. Oakley Road, Chesaning, MI 48616, (517) 845-6073.

