Southern Equine Consortium
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Maximizing the Financial Return from Broodmares

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Admittedly, not all mare owners are breeders with expectations of making a profit. If they are claiming their horse operation as a business for tax purposes, they must at least show evidence of "intention to make a profit". Regardless of the scenario, it would be safe to assume that all breeders would like to minimize their losses.

Economic analysis of broodmare management practices is relatively scarce in the scientific literature. Bosh and others (2009) examined the production records of 1176 Thoroughbred mares in central Kentucky (over 7244 mare years) to determine the effects of reproductive efficiency over time on mare financial returns. They determined that over a 7 year investment period, live foals must be produced in all but one year to yield a positive financial return, noting that mares are a long term investment due to the delay in return on investment. They found that 63% of mares did not produce a foal every year but brood mares produced for an average of 3.4 years before NOT producing a foal. Interestingly, a majority of the mares drifted in foaling date with subsequent foaling seasons. The probability of producing a registered foal decreased with increasing mare age, foaling after April 1st and multiple matings per conception.

Logically, in order for a broodmare to provide annual income, she must produce a marketable foal each year she remains in the herd. Therefore, reproductive efficiency is paramount in maximizing financial return from broodmares. Among well-managed Thoroughbred mares only 82.7% (Morris and Allen 2002), 79.8% (Hemberg et al. 2004) and 78.3% (Bosh et al. 2009) produced a live foal.

Although feral horses reproduce with levels of efficiency that rival other domesticated species, managed horses have some unique reproductive challenges.

1. Genetic selection pressure is on performance traits rather than reproduction/fertility.
2. Breed registries' Universal birth date of January 1st, coupled with seasonality (average date of 1st ovulation April 1), and pressure to compete at a young age create an "imposed" breeding season of February 15 through June 15th in order to produce early foals.
3. Imposed season causes owners to attempt breeding mares during the period of transition.
4. Average gestation length of 340 days leaves a 25 day window to maintain a1 year foaling interval. Breeding on foal heat estrus is often associated with early embryonic loss.
5. Higher value mares or mares with foals that have sold/performed well are often allowed to remain in the breeding herd even after reproductive inefficiencies are evident.
6. Generation interval (time required to replace the mare) for horses is 4-6 years.

Brood Mare Selection/Evaluation

Pedigree, performance and progeny (the 3 P's) are the primary drivers in cost/value of brood mares and will consequently impact the value/profit of the foals they bear. However, a mare that scores high in the 3 P's has little value as a broodmare if she cannot consistently produce foals. Though there is no guarantee of a foal each year, performing a breeding soundness exam can alert you to potential problems and allow you to assess your risk before making a large investment of time and money. The more extensive the evaluation, the more informed your decision making process.

An in-depth review of the mare's medical, management and breeding history is the place to start. Age, vaccination history, feed, previous use, intended use, surgical history, disease problems, weight gain or loss, are some general considerations. Reproductively, consider breeding status (maiden, barren, open, pregnant), age of first breeding, breeding method, number of years bred, number of foals born, average date of first annual ovulation, ovulation interval, size of ovulatory follicles, teasing behavior, foaling dates, incidence of dystocia, foal heat ovulation and mothering ability. If poor management is the cause of poor performance, that can be overcome.

Maximizing the Financial Return from Broodmares, continued.

A complete physical and reproductive exam will allow you to determine if problems are correctable. The physical exam includes things that may contribute to breeding problems. Poor feet and leg structure or chronic lameness issues will make the mare unable to withstand the act of breeding. A mare in thin body condition will have delayed onset of the breeding season, require more cycles per conception and have a higher incidence of embryonic loss than mares in good flesh. Mares with pelvic abnormalities may be at risk for foaling difficulty. Mares with overshot or undershot jaws and/or in need of dental care may have difficulty utilizing feed and forage efficiently and therefore may lose weight and condition.

Reproductive exams should be done during the breeding season for the most accurate estimate of breeding potential. External genitalia should be examined for conformation that might lead to pneumovagina (windsucking), urine pooling or fecal contamination. (A mare with poor vulva conformation should have a Caslick's placed after breeding and confirmed ovulation.) Performing a rectal exam via palpation and/or ultrasound examination will allow determination of pregnancy status, cyclicity, follicle size, uterine tone and abnormalities. Vaginal and cervical exam using a speculum may reveal injuries that could influence the mare's ability to maintain a pregnancy. Uterine culture and cytology assist in determining if a mare has a uterine infection. Negative cultures are required in many live cover scenarios. Endometrial biopsies result in a score that relates to the mare's chance of carrying a foal to term.

Fooling Mother Nature

The mare is seasonally polyestrus with day length serving as the environmental cue that synchronizes the breeding season with the time of year when survival of the foal and rebreeding is optimal. During short days, hormone levels are low and ovaries are small and inactive. As days lengthen following the winter solstice, mares will undergo a transition period during which they grow follicles and demonstrate erratic estrous behavior but do not ovulate. Around the first week of April, mares will grow an ovulatory follicle and will continue to have ovulatory cycles regularly through late summer/early fall unless they become pregnant.

With the universal birth date of January 1st and economic drivers for performance at a young age, breeders often push mares to foal in January. Considering that average gestation length in mares is 340 days, a mare must be bred in February to accomplish this. Mares placed under 2 hours of additional light at dusk beginning the last week in November and continuing through breeding will undergo transition earlier in the year and should begin ovulating in February (Sharp et al 1988). Use of extended day length has also been shown to shorten gestation length and reduce the interval to rebreeding in pregnant mares (Hodge et al 1982).

Caveats: 1. Horse owners living in extreme northern climates should consider that shedding of the hair coat is also a response to increased day length. 2. Horses need a period of short days in order to respond to the lights so beginning earlier or leaving horses under lights year round are counterproductive. 3. If you begin placing your mare under lights and then ship her to a breeder, it is imperative that the mare continue under lights until she is bred.

Breeding Post Foaling

Yearly foaling is important to maintain profitability. Average gestation length affords the brood mare manager a narrow 25 day rebreeding window to prevent the mare from drifting later in her foaling date each year. Mating on foal heat is a common practice to improve the chances of maintaining early foaling dates. The primary disadvantage is the increased occurrence of pregnancy loss in mares conceiving on foal heat matings. The decision to breed on foal heat should be made on an individual basis considering conditions of her foaling and her progress post-foaling. Mares should be evaluated day 6-8 post foaling then every other day until ovulation. Any mare that has a complicated birth, delayed passage of the placenta, genital tract trauma, or delayed uterine repair should not be bred on foal heat (Blanchard & Macpherson, 2011).

Financial evaluation of breeding individual mares can provide valuable information. Photo by N. Walker, Gray Ranch.

Mares typically return to estrus 5-12 days post-foaling and ovulate day 10-20 (Loy, 1980). In a normal mare, uterine involution occurs by day 15 on average. Pregnancy maintenance is dependent on a healthy uterine environment. After breeding, the embryo remains in the oviduct until about day 6.5. If a mare ovulates day 10 or later post foaling, breeding on foal heat has a reasonable chance of being successful because the embryo will not arrive in the uterus until day 16 or later. Mares ovulating before day 10 should not be bred on foal heat. Rather, skipping foal heat and giving the mare a shot of prostaglandin day 5-6 post ovulation to "short cycle" her gives her a little more time for repair yet shortens the time to rebreeding compared to a spontaneous return to estrus.

Maximizing the Financial Return from Broodmares, continued.

Managing the Estrous Cycle
Though a stallion will mate a mare several times during a heat period in a pasture mating situation, there are cost savings as well as health advantages for mating mares only once per ovulation. Costs associated with the mating process might include hauling the mare to the stallion, booking fee, collection fee, shipping fee, and insemination fee. When a mare is bred multiple times per heat, the fees are multiplied. From a health standpoint, consider that when a mare is bred, there will be a uterine inflammatory response. Following insemination the sperm cells move quickly up the oviduct (~4 hours) and the seminal fluid remaining in the uterus must be cleared out. The routes of elimination of the seminal fluid are the lymphatic system and the cervix aided by uterine contractions. Older mares with stretched and sagging uterine horns as well as compromised lymphatics, often have uterine clearance issues. Uterine lavage along with oxytocin administration 6 hours post breeding have been shown to be effective in improving conception rates in mares with clearance issues (LeBlanc, 1994).

If your only breeding tool available were teasing scores and previous breeding records, you would likely cover your mare every other day, beginning on day 3 of heat, until she went out of heat. If you have access to palpation and ultrasound, you can do a fair job of predicting ovulation, allowing you to book a stallion only once or request a single shipment of semen. Through rectal exams every other day during heat you can track follicle size, shape, and softness, estrous edema, uterine tone and cervical score. A comparison of the cost of diagnostics versus multiple covers would help you decide the best approach. In addition, hCG or GnRH injection in a mare with a follicle greater than 35mm should result in ovulation 36 – 48 hours post injection. Again, there is a cost associated but that cost is recovered if you prevent the need to order a second shipment of semen.

Breeding Tools
There are a number of tools available to enhance reproductive efficiency. As you plan and prepare for your breeding season consider if you wish to us artificial lights to hasten the onset of the breeding season. Developing a teasing program and record keeping system is foundational to reproductive management. If using artificial insemination, determine the collection schedule and requirements of the stallion manager and establish good lines of communication.

If you are going to use hormones, determine which ones, how and when you will use them and work with your veterinarian to have them available (hCG, GnRH, oxytocin, Regumate). Determine what your standard procedure will be regarding rectal exams. For example: beginning day 3 of heat, check every other day through confirmation of ovulation, then day 14 post ovulation, day 30 (heartbeat), day 45 and day 60 (gender determination)? If you have a double ovulation, you will need to check for twins and potentially crush one if they persist. Some people try to cut costs by using the veterinarian as little as possible. This often results in increased costs in the long run due to missed ovulations and pregnancy failure. Sometimes in addition to counting the cost for a procedure, you should consider the possible consequences of NOT doing the procedure. Ask if it is worth the gamble.

Stochastic Process
What is the likelihood of a mare producing a live foal every year? According to Bosh (2009), this is a stochastic process. Stochastic is a statistical term meaning random, involving probability or guesswork. Is Bosh saying “Your guess is as good as mine”? Economic consequences of management decisions affecting reproductive efficiency are routinely studied in food animal species but rarely in the horse industry. This is not surprising when you consider the fact that cows or sows no longer producing offspring are culled from the herd and moved into the food chain but brood mares are often kept around well beyond their productive years.

Counting the Cost
Cost calculation is a management tool that is often ignored. You may calculate cost per mare per year but cost per foal produced accounts for the mares that failed to produce a foal but were maintained in the herd. Variable/direct costs are those which directly impact production like feed, fuel, fertilizer, repairs, veterinary supplies and services, etc. Fixed costs/overhead are costs that occur regardless of level of production like equipment and facility depreciation, land taxes, family living expenses. Before a manager can reduce costs, they must know what their costs are and how they are allocated. When cost savings are identified, consideration must be given to the risks associated with reduced input. For instance, if changing to a less expensive, lower quality feed causes your mares to lose body condition and subsequently require more cycles per conception, the cost savings is no longer relevant.

There are no “one size fits all” recommendations for maximizing the financial return from broodmares. It is no surprise that in Bosh’s Thoroughbred study, the most valuable mares afforded the greatest profit. Similar to other investments, there are financial risks associated with raising, buying and/or breeding mares. One thing all mare owners should have in common is that the end goal is to produce a marketable foal. Many of the costs incurred in breeding horses will be the same whether you are breeding high end horses or pasture ornaments. To that end, it is wise to buy the very best that you can afford.

Maximizing the Financial Return from Broodmares, continued.

A final note regarding financial return from broodmares is the fundamental question: “should I breed this mare?” Obviously if you do not breed a mare there will be no product to sell. However, if the potential foal is not likely to bring a price that covers the cost of breeding the mare and raising the foal to a sellable age, you might be money ahead to leave the mare open. In this scenario, rather than increasing your profit you are settling for reducing your losses by choosing to NOT breed. You might think of this in a similar way as investing in the stock market. You invest with the hope that the market will be good at a later time. Reducing your losses by not breeding a mare, in some scenarios, is a sound financial decision. This choice could also be considered a service to a horse industry that is struggling with the issue of “unwanted horses”.

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Estimating Winter Hay Needs for Horses: As Temperatures Fall, Consumption Increases

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Round bales can be an efficient way to feed horses hay during winter. Photo by D. McIntosh, UT Beef and Forage Center.

It’s time for horse owners to make plans for the colder weather ahead. For most horses, cold weather does not mean coming in from the cold, but being provided with the necessary nutrients to ensure they are as comfortable as possible. Planning ahead for how much hay is needed for feeding all winter is essential for maintaining healthy horses.

Jennie Ivey, University of Tennessee Extension equine specialist, says ideally, a horse should consume between 1.5 percent to 2 percent of their body weight of hay or forage per day (dry matter basis). For example, a 1000 pound horse will eat 15 to 20 pounds of hay daily. That’s the equivalent of roughly one small square bale of 40-60 pounds every few days. The exact number of bales needed for winter feeding will depend on the weight of the bale.

“It is best to determine how much your horse will need to get through the winter based on their daily consumption” Ivey states, “Next, determine the total amount of hay needed,” she adds.

Low temperatures, high winds and precipitation can increase the amount of energy horses need per day. “That means during extreme conditions you may need to increase the amount of hay horses consume. Supplementation with grain or concentrate is needed when a horse is having difficulty maintaining weight or body condition,” she cautions.

Round bales are also a good option for horse owners, especially for those needing to maintain horses outside. On average, between 7 to 10 horses can consume one round bale (800-1200 pounds) in 3-4 days. Feeding round bales out of a feeder can greatly reduce waste and ensure that horses have access to fresh hay even during inclement weather.

Not all hay is created equal. Ivey recommends having your hay tested for nutrient content to ensure it meets the horse’s nutritional needs. Forge analysis can be performed by the UT Soil, Plant and Pest center (ag.tennessee.edu/spp). Ivey also reminds owners to check all hay for mold and dust before feeding. “Dusty hay can lead to respiratory problems, while moldy hay can cause colic,” she says.

For help estimating your horse’s weight, having your hay tested, interpretation of forage tests, or any other equine related questions visit UTHorse.com.

Texas A&M University Researches Effect of Heat Stress on Stallion Semen Characteristics

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Many horsemen have long held the belief that intensive work by performance or racing stallions in a hot environment could be detrimental to semen quality and might influence breeding performance. Graduate students mentored by faculty researchers in Animal Science, Dr. Sigler, Cavinder (now at Mississippi State) and Vogelsang, along with collaborators in the College of Veterinary Medicine, Dr. Varner, Love and Blanchard have recently completed several research projects investigating this subject.

Initially, researchers needed to develop a method to accurately determine internal scrotal temperatures which could be compared to surface, rectal and environmental temperatures. Using Miniature Horse stallions, subdermal thermosensory devices which could be read by portable scanning units, were implanted into the ventral portion of the scrotum. Scrotal temperatures during and after exercise during hot, humid environmental conditions were then compared to subcutaneous neck temperatures, read from implanted thermosensory devices in the neck, and normal rectal temperatures.

One of the interesting early results noted by researchers was the further documentation of the stallion's inherent ability to dramatically reduce scrotal temperature, compared to rectal temperature, during exercise-related heat stress. In horses which were exercised in a hot environment for a total of 90 minutes, there was an average 7.9^{o} Fahrenheit difference between rectal (102.7) and scrotal (94.8) temperatures at the end of exercise.

After conducting three different trials in which exercising horse were compared to non-exercised controls, however, there appears to be very little effect of elevated rectal temperatures, due to exercise, even in the presence of hot, humid conditions, on semen volume, sperm concentration, total sperm numbers, percentage of total and progressively motile sperm, sperm morphology or sperm DNA quality. In conclusion, we can infer that stallions may be moderately exercised for short periods of time in hot, humid environments without fear of inducing testicular temperatures capable of inflicting damage on reproductive variables.

Stallions can be exercised in hot, humid environments for short periods of time without harming its reproductive capabilities.

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Ring Around the Foot

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The horse's foot is constantly breaking down with various changes in work and environment. Frequently, these changes surprise horse owners and farriers alike to manage the aftermath. Some of these changes in the hoof may be recognized as small vertical cracks, a horizontal crack or horizontal rings around the foot. The horizontal rings around the hoof have various names that you may recognize, including stress, dew, growth, fever, or founder rings. Typically, hoof rings occur due to stress factors and indicate breakdown, yet are one of the best barometers of hoof health and balance.

Ring Around the Foot, continued.

The horse's hoof not only provides a protective cast around the structures internally but serves to raise the bony column from receiving direct ground reaction force. This unique adaptation enables a large body mass like a horse to perform more efficiently. When the hoof grows in length the horse's body weight transfers from the sole and frog to the to the hoof wall. As hoof length continues to increase, the bony column continues to raise up and away from having direct contact with the ground, which is needed for proper hoof balance. With the bony column further removed from weight bearing more stress is placed on the hoof wall. The additional hoof wall strain, eventually leading to loading failure and rings to form. The foot will grow to a point of breakdown that will occur and reset weight bearing with other hoof structures like the sole and frog and the cycle begins again. It is necessary for the hoof to have optimum health to handle this constant cycle of growth and breakdown.

An important thing to remember about hoof rings is that they do not originate down on the hoof where they are seen, but rather in the coronary band (hairline of the hoof capsule). Rings are common in all feet; however, concern is centered around their severity, and if they are concentric or even around the entire hoof capsule. Also, attention is given to determine if rings are present in all four of the horse's hooves. Frequently the appearance of these rings can be seen identically in all four feet.
We know rings occur because of the hoof's natural bio-mechanical structure transferring weight bearing; but why? The hoof is the most interactive body part with the environment and is the location of primary loops in the body's circulatory system. Since the hoof is highly vascular, the hoof can not only reflect changes in the footing and ground moisture, but also changes in systolic blood pressure and nutrition.

In the perfect world the hoof wall would not break down under the pressures of life. Few horses have a foot that does not display horizontal rings mapping events and the lifestyle they lead. It is important to note the frequency or space between rings. Particular attention to severe rings can possibly be a reminder of an event or season, and a chance to alter management practices in the future. Whatever the reason the foot provides a history in the growth rings on many of the factors that influence good hoof health.

What can you do? As a care giver the goal is to keep these rings to a minimum in occurrence and severity. The environment in the southeast, especially Tennessee, is very moist and necessarily means that horses will have softer feet than in other regions of the country. Frequently, changes on feet may occur simply from moving to another field on the same farm. When considering the care program for your horse, use these rings as a guide for future treatment. If the frequency or severity of rings is reduced then you are on the right track. The best professional health care provider with advice for this is your farrier.

The farrier is much more in touch with hoof care problems in your area than most equine professionals. The frequency of hoof care service necessarily makes your farrier a source of information that can head off potential causes that lead to the breakdown that rings indicate. At a minimum it is a good subject for communication with your hoof care provider. Recommendations for trimming frequency, topical applications, and adequate protection of the foot are all subjects the farrier answers multiple times a day.

Visit with your farrier, try some of their suggestions and see if you can eliminate some of those nasty rings around your foot. For more information on hoof care, equine health and other horse-related information, visit UTHorse.com.

Hoof health and balance can be evaluated by hoof rings caused by various stress factors. Photo by D. Hurst, UT School of Veterinary Science.

Development of an Equine Non-Contact Thermography Device

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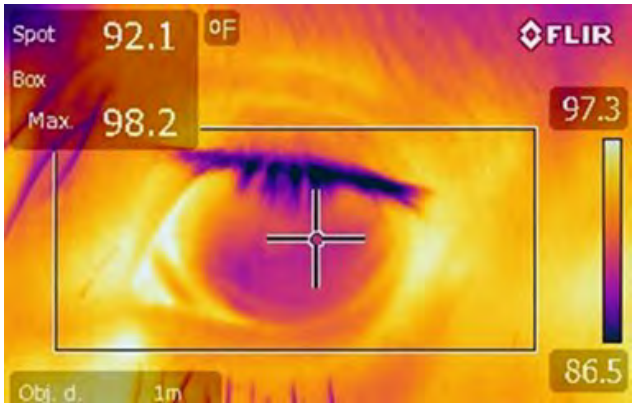


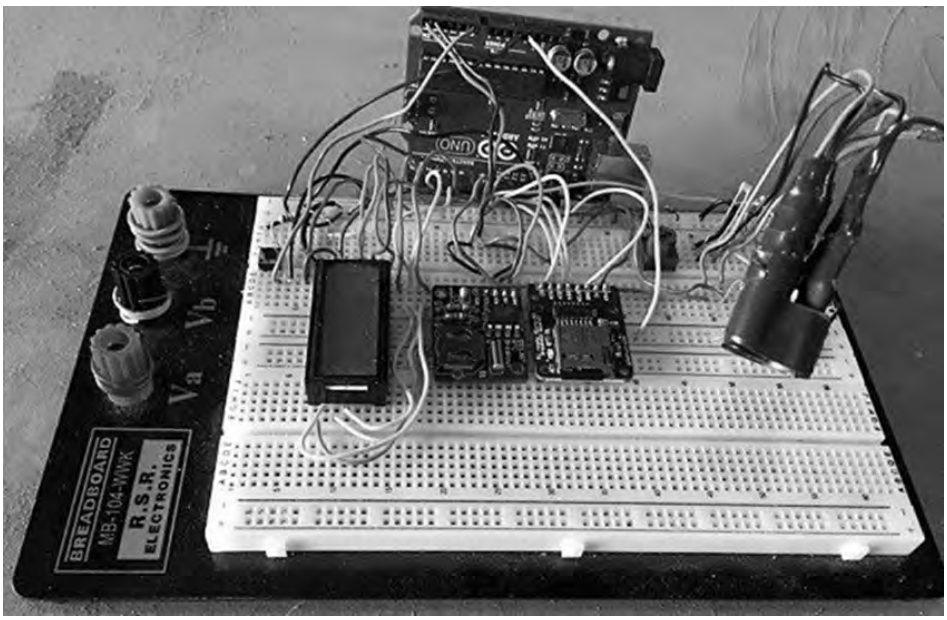
FLIR® E60 Thermal Image of the equine eye. Photo by J. Leatherwood, SHSU

The equine industry is heavily dependent on the gathering of mass numbers of animals in the form of races, shows, rodeos, fairs, and other educational and competitive functions. These large assemblies of horses run a high risk for spread of infectious diseases, and an effective method of temperature collection can be opportune for prevention. If, upon arrival to an event, animals could be screened for illness prior to admittance into the facility, the biosecurity of the event would be enhanced, allowing for a greater population of animals with sound health.

Currently, the industry standard for determining body temperature involves the use of a rectal thermometer. Unfortunately, this method may be a safety risk for handlers and unfavorable to the animal. While the use of a rectal thermometer is widely regarded as the most effective industry practice, more modern methods are being developed and tested including Infrared Thermography (IRT) devices. Benefits of this technology include rapid temperature detection and a lack of invasiveness. IRT is a technology that detects infrared energy on the surface of an object and produces a temperature and depending on the specific device, an image displaying temperature distribution.

Faculty within the Agricultural Sciences and Engineering Technology Department at Sam Houston State University has developed a first generation prototype for use as a non-contact thermography device (NCTD). Researchers are currently working to compare a first generation prototype non-contact thermography device (NCT) to a traditional FLIR® E60 Thermal Imager (FLIR Systems Inc., Austin, TX), as well as, determine the relationship between rectal and thermographic surface temperatures as a potential indicator of health status. The goal of this work will be to produce a product that will be relatively inexpensive, yet effective in obtaining body temperature measurements of the horse that will be accessible to participants in the industry.

Adjustments to improve the accuracy and utility of this device are currently ongoing. Data is currently being collected within a controlled environment, with additional opportunities to test this device under field conditions. This will provide the ability to detect health status in a timely manner with minimal restraint or handling related stress. *For additional information, please contact Jessica Leatherwood at Sam Houston State University (jll056@shsu.edu).*



Non-Contact Thermography Device (NCTD) development board created by the Sam Houston State University Agricultural Sciences and Engineering Technology Department. Photo by J. Leatherwood, SHSU.

Monitoring Body Condition in Horses: Helpful Smart Phone Apps for Horse Owners

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Maintaining proper body condition is vital to horse health, performance, and welfare. The Body Condition Scoring (BCS) scale developed by Dr. Henneke is a method of evaluating the amount of fat on a horse's body. This system is used by equine nutritionists, veterinarians, agriculture law enforcement personnel, horse farm managers, and horse owners to accurately assess a horse's condition. The scale ranges from one to nine, with 1 being very thin and 9 being obese. The level of condition is evaluated based on visual assessment and palpation of fat deposits. The areas of the horse's body emphasized in BCS are shown in (Figure 1).

The ideal BCS for a given horse should be 5 to 6 out of 9, however the recommended body condition score may vary depending on the stage of production. For example, horses in heavy race training would be expected to have a BCS of 4 to 5, and a BCS of 6 is considered ideal for broodmares entering the breeding season. Many factors can affect a horse's body condition including food availability, exercise/work activities, season/weather, parasites, dental problems, and feeding management practices. Becoming familiar with how to evaluate body condition and including BCS monitoring as part of your management will allow you to keep your horse(s) at a healthy weight and to more quickly identify and alert your veterinarian to potential problems.

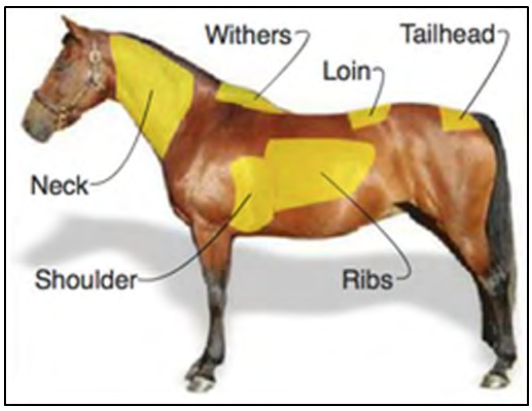

Figure 1. Areas of the horse's body used to evaluate and assign a body condition score (BCS). Photo by eXtension Horses BCS App.

Newly developed tools are available to assist horse owners and farm managers with recording and monitoring BCS in horses. The Horse BCS App developed by eXtension Horses is available for Smart Phones through iTunes and Google Play for a cost of $1.99. The app includes both learn and score features as well as video tutorials on how to assess BCS. The app allows you to take a picture of the horse and to assign a score taking into account each of the six areas of the horse's body used to evaluate BCS. The picture and BCS are date stamped and archived for future reference allowing comparison between previous and later scores (e.g. at different time points throughout the year). Other useful BCS and body weight calculator apps for horses include the Horse Health Tracker App developed by Equine Guelph (http://www.equineguelph.ca/Tools/app.php), and the Healthy Horse App developed by the University of Minnesota (http://www.extension.umn.edu/agriculture/horse/apps/).

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