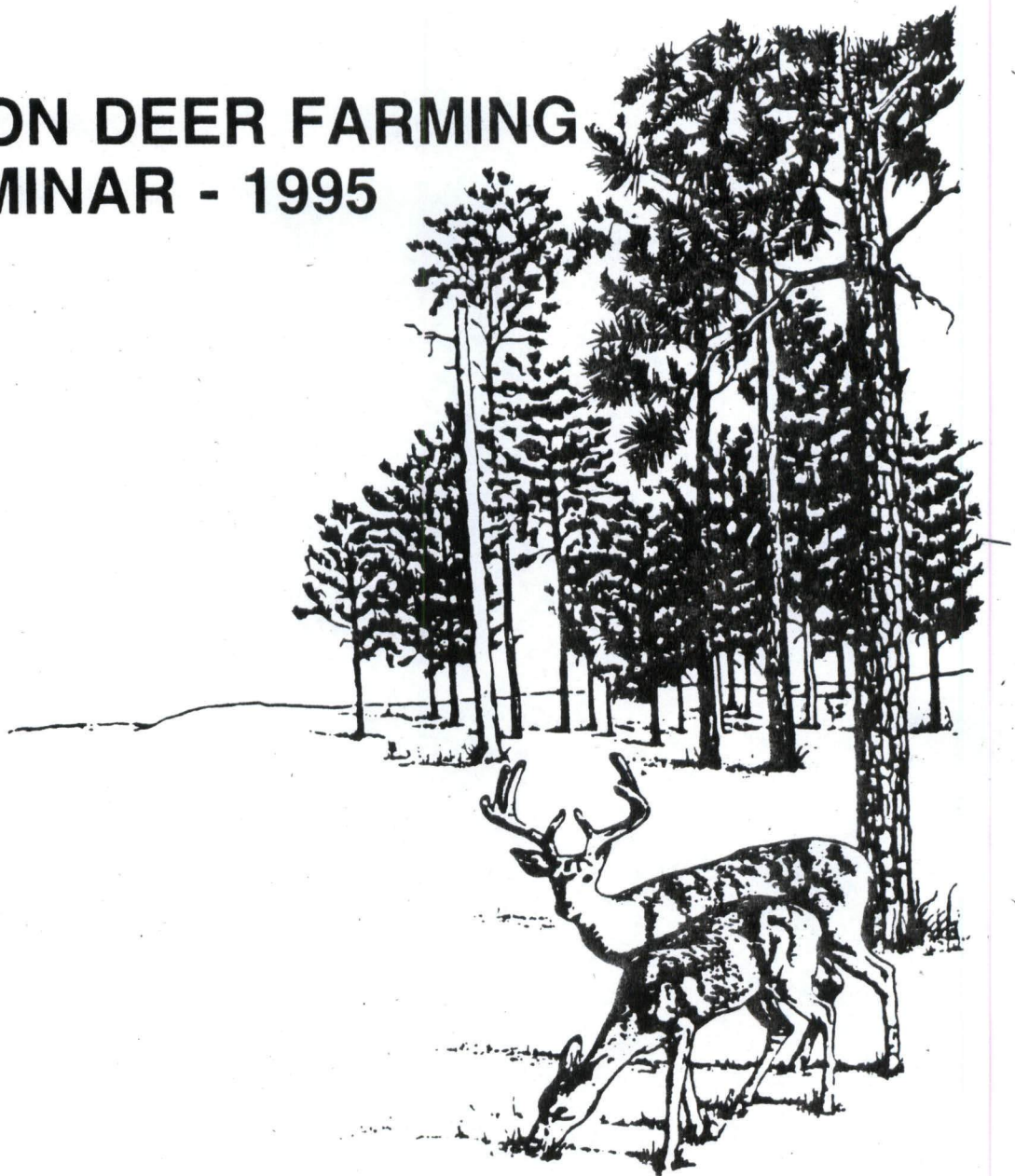




Texas Agricultural Experiment Station
Texas Agricultural Extension Service
The Texas A&M University System

OVERTON DEER FARMING SEMINAR - 1995



1995
Research Center
Technical Report

No. 95-1

Texas Agricultural Experiment Station • Edward A. Hiler, Vice Chancellor
The Texas A&M University System • College Station, Texas

REPRODUCTIVE MANAGEMENT OF FEMALE CERVIDAE

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Background. Deer farming has progressively grown into an industry in the United States and around the world. Venison and seed stock production have become the focus of deer production systems due to an increasing demand for leaner alternative red meat sources and a need for more diversified agriculture to compliment current livestock production schemes. Deer producers, however, require information concerning the reproductive status of their herds from which herd strategies may be formulated. By investigating the interactions between different nutritional states and the physiological mechanisms involved in deer growth and reproduction, information may be obtained which may ultimately aid deer producers in achieving more effective management of their herds.

The following is a synopsis of the research which has been on-going at the Texas A&M University Agricultural Research and Extension Center at Overton with regard to the reproductive management of the female cervidae. The importance of maintaining does in good condition throughout the year and effectively utilizing current reproductive technologies are synonymous with achieving the maximum reproductive potential from production herds. We have tried to be diverse with regard to the species of deer we have investigated in an effort to aid as many producers as possible. At the same time, it must be emphasized that while the underlying themes are applicable to all species of deer, the specifics of the data discussed may vary from species to species and with regard to different environmental and managerial circumstances.

Research Findings/Current Information.

1. *Weight Change and Body Condition Affects Pregnancy Status.* Body condition has been previously shown to interact with the nutritional plane of an animal before breeding. Assessing weight change and body condition scores prior to and during the rut may provide producers with additional measures for assessing their herd reproductive potential. With the help of Game Ranching, Inc. (Ingram, TX) and Blazing Saddles Ranch (Winona, TX), sika (*Cervus nippon*) and Rocky Mountain elk (*Cervus elephus nelsoni*) were pregnancy tested, using ultrasonography, at selected intervals during the breeding season and evaluated with regard to body condition score and body weight. Among sika, those that were open at the time of ultrasonography had a greater weight loss over a three month period than did those that were pregnant at ultrasonography (Figure 1). Similarly, body condition scores for elk cows that were determined to be open at the time of ultrasound were significantly lower at both testing periods.

a 3 month interval, compared with those cows observed to be pregnant at the time of the ultrasound (Figure 2). Body condition scoring has been adapted from domestic livestock production systems, with a score of 1 being emaciated and 9 being obese. Both sika and elk breed during short-day period when forage quality and quantity may be reduced. Therefore, using body condition scoring as well as monitoring changes in liveweight during the breeding season, deer producers may evaluate the condition of their herds during this critical time.

Figure 1. Weight change in sika does relative to pregnancy status

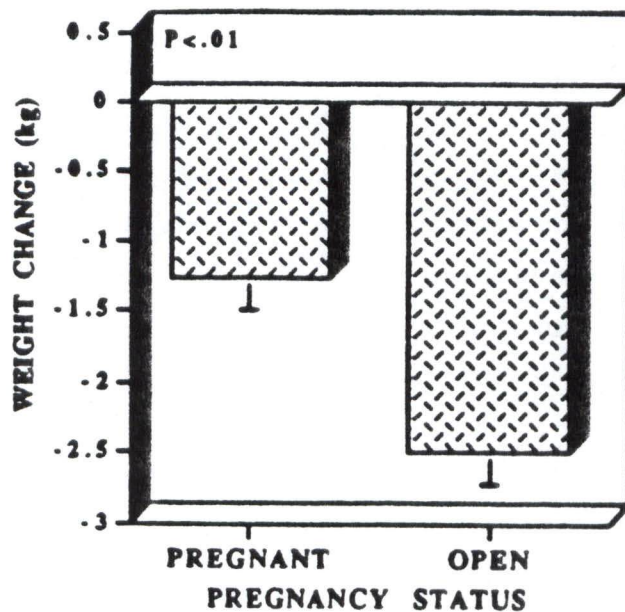
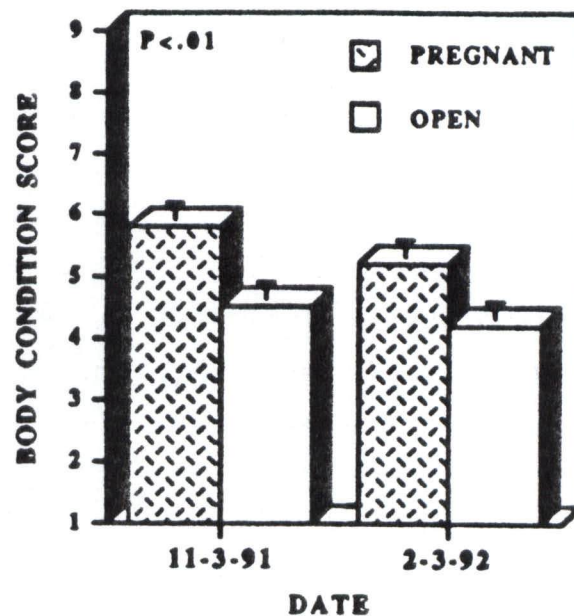


Figure 2. Body condition scores for elk cows relative to pregnancy status



II. *Estrous Synchronization and Artificial Insemination.* Artificial insemination (AI) has proven to be a powerful tool in animal agriculture. It enables the producer to enhance the genetic quality of the herd through the infusion of superior traits such as increased body size and antler growth. In order to effectively utilize AI in deer, the ability to synchronize estrous in the does for timed inseminations becomes paramount. In a series of studies conducted with sika does at Game Ranching, Inc. (Ingram, TX), various concentrations of pregnant mare serum gonadotropin (PMSG), a hormone which aids in enhancing the ovulatory process in some deer species, were administered by intramuscular injection following removal of a controlled intravaginal progesterone releasing device (CIDR), a plastic intravaginal implant containing the hormone progesterone which synchronizes the does, which were inserted for 13 days in an effort to determine the effectiveness of these procedures for artificial insemination. While adequate

numbers of sika does within specific dose and semen/sire groups are lacking, our results (Table 1) indicated that 50 to 100 IU of PMSG produced more pregnancies than 0 or 150 IU of PMSG. Further research is needed to determine the proper timing of insemination and to refine AI procedures in sika relative to the original (i.e., sire) and state (i.e., fresh or frozen) of the semen utilized in these procedures.

Estrous synchronization devices, such as the CIDR, have been difficult to obtain for many producers and veterinary practitioners. Alternatives are available, however, which are economical, relatively easy to use and are an effective means for estrus synchronization. In a continuation of our studies at Game Ranch, Inc., six sika does received CIDR implants and six received a norgestomet ear implant (Syncromate-B, Sanofi Animal Health, Overland Park, KS), a synthetic form of progesterone, for estrous synchronization. After 11 days, implants were removed, each doe was administered 50 IU of PMSG and then randomly assigned to one of two pens containing a silk sire (sika x elk). Does were observed for 72 hours following implant removal for signs of mounting behavior and estrus activity. Results indicated that the time to standing estrus and/or breeding was similar between does synchronized with CIDR and half norgestomet ear implants (Table 2).

Table 1. The effect of PMSG dose on pregnancy rates in sika does artificially bred to elk and silk (sika x elk).

PMSG Dose (IU)*	Semen/Sire	Total #	# Open	# Pregnant	% Pregnant
0	fresh/elk	12	9	3	25.0
0	fresh/silk	8	7	1	12.5
50	fresh/elk	7	2	5	71.0
50	fresh/silk	9	6	3	33.3
100	fresh/elk	10	4	6	60.0
100	fresh/silk	5	3	2	40.0
100	frozen/elk	19	11	8	42.1
150	frozen/elk	14	12	2	14.3

*Note: Use of PMSG in synchronization protocols is not recommended in all species of deer.

Such information indicates that the timing of insemination following norgestomet implant removal

would be identical to those protocols which utilize the CIDR in sika deer. Our laboratory has also utilized one-half of a norgestomet ear implant in fallow deer and obtained effective estrous synchrony and pregnancy rates following implant removal. Producers may utilize these estrous synchronization procedures for timed AI procedures as well as timed natural matings to more effectively control breeding and fawning periods.

Table 2. Timing of estrus in sika does synchronized with CIDR and half norgestomet ear implants following implant removal and 50 IU of PMSG.

Item	CIDR	Norgestomet*
Incidence of estrus	4/5	6/6
Time to standing estrus/breeding (hr)	34.57	36.23
Range (hr)	29.70 - 37.75	28.25 - 45.87

*Norgestomet - consisted of a 1/2 ear implant (Synchromate-B, Sanofi Animal Health Inc., Overland Park, Kansas).

III. *Methods for Pregnancy Detection and Factors Influencing the Reproductive Performance of Production-Based Herds.* Several methods have been utilized for pregnancy diagnosis in deer including ultrasonography, serum progesterone, estrone sulfate and pregnancy-specific protein B (PSPB). Pregnancy detection provides deer producers with information concerning the reproductive status of their herds from which herd strategies may be formulated. Ultrasonography and blood sampling were conducted at various times in Rocky Mountain elk and fallow does (*Dama dama*) to determine the effectiveness of various hormonal methods, progesterone, estrone sulfate and PSPB, in detecting pregnancy. In elk, at the end of the rut, ultrasonography was 92% effective and progesterone was 95% effective, while estrone sulfate and PSPB were 100% effective in diagnosing pregnancy. Further studies are needed using timed artificial insemination or natural service to determine how early post-conception these methods may be utilized and their relative accuracy for pregnancy diagnosis in elk.

An additional study was conducted at the Texas A&M University Agricultural Research and Extension Center in Overton, TX, using 10 fallow does provided by Heart-Bar Deer Farms, Inc. (Hondo, TX), to investigate the use of serum progesterone, estrone sulfate and PSPB in

detecting pregnancy. Each doe was estrous synchronized using intra-vaginal progesterone releasing devices (CIDR) and blood samples taken every 2 to 3 days following 7 days of buck exposure until day 90 post-breeding and at day 200 post-breeding. Progesterone profiles for pregnant does demonstrate that after day 20 progesterone continues to rise, while in open does progesterone decreases until the next reproductive cycle (Figure 3). Estrone sulfate may be most effective when used after day 62 post-breeding, when concentrations become considerably higher than in open does (Figure 4). Pregnancy-specific protein B first appears in the blood by day 24 to 27 post-breeding and remains throughout gestation while in open does PSPB is not detectable. When breeding dates are known, as is the case when artificial insemination, embryo transfer or estrous synchronized natural matings are utilized, progesterone, estrone sulfate and PSPB may all provide effective means for pregnancy detection in fallow does.

In an effort to further demonstrate the use of these methods for pregnancy detection and further investigate the dynamics of a production herd of fallow does, a study was developed in cooperation with Heart-Bar Deer Farms, Inc. (Hondo, TX). In this study, fallow does (n=500) of various ages, breeding groups and of known previous reproductive histories were sampled at regular intervals following a 60-day breeding season. Each doe was monitored by ultrasound as well as hormonal means (PSPB analysis) to try and establish a link between a doe's previous reproductive history, body condition (i.e., age and weight change) and pregnancy status. The result indicated that both ultrasonography and PSPB were relatively accurate tests following 30 days after buck removal. We further found that the age of the doe and the type of sire utilized did not significantly affect pregnancy rates among fallow does (Table 4). In yearling does, fall body weight (i.e., body weight prior to the breeding season) did not influence the pregnancy rate in these does. In mature does (does > 2 years of age), however, does with fall body weights less than 80 lbs and greater than 96 lbs had lower pregnancy rates than does between 81 and 96 lbs (Table 5). Another factor that significantly affected pregnancy status was the previous reproductive performance of the does. This was tested relative to whether the doe was wet (i.e., the presence of milk or significant mammary development) or dry (i.e., no milk or mammary development) following weaning prior to the breeding season. We found that does tested as dry the previous season had lower pregnancy rates (77.8%) than does tested as wet (94.7%). Further analysis of our results also revealed that 84.2% of the does became pregnant on the first estrous cycle following buck exposure, and that the overall incidence of embryonic mortality was relatively low (2.8%). This information emphasizes the importance of monitoring the age, weight and previous reproductive performance of does within the herd to maximize reproductive

performance and overall production capability.

Table 4. The effect of doe age and type of sire on pregnancy status in fallow does.

Age of Doe	Type of Buck	Pregnancy Rate	
		Number	%
Mature	1/2 Danish + Hungarian	88/100	88.0
Mature	1/2 Mesopotamian	90/100	90.0
Mature	1/4 Mesopotamian	97/100	97.0
2 years	Heart-Bar European	93/100	93.0
1 year	1/2 Mesopotamian	94/100	91.3

Table 5. The effect of fall body weight on pregnancy rate in mature fallow does (>2 years) prior to the breeding season.

Body weight (lbs)	Pregnancy Rate	
	Number	%
≤ 80	31/37	83.8
81 - 95	217/230	94.3
≥ 96	26/32	81.2

IV. *Stress-Related Hormones and the Maintenance of Pregnancy in Fallow Does.* Stress has been implicated in several species of deer as having a negative impact on production performance under intensive farming conditions. The stress response of an animal is responsible for redirecting its energy in times of stress (i.e., capture and handling) toward an appropriate response such as to flee or fight. This response under farming conditions can lead to a reduction of feed intake and poor reproductive performance. Cortisol, a hormone secreted by the adrenal

Figure 3. Serum progesterone in pregnant (n=5) and open (n=2) fallow does following estrous synchronized natural matings

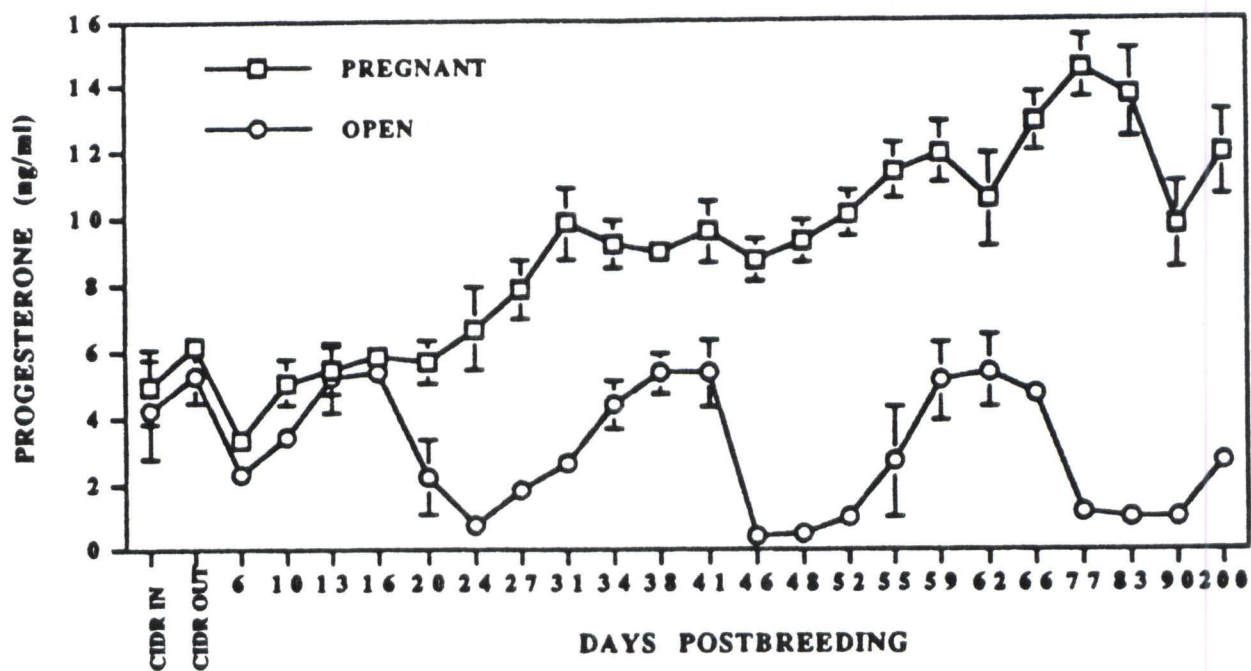
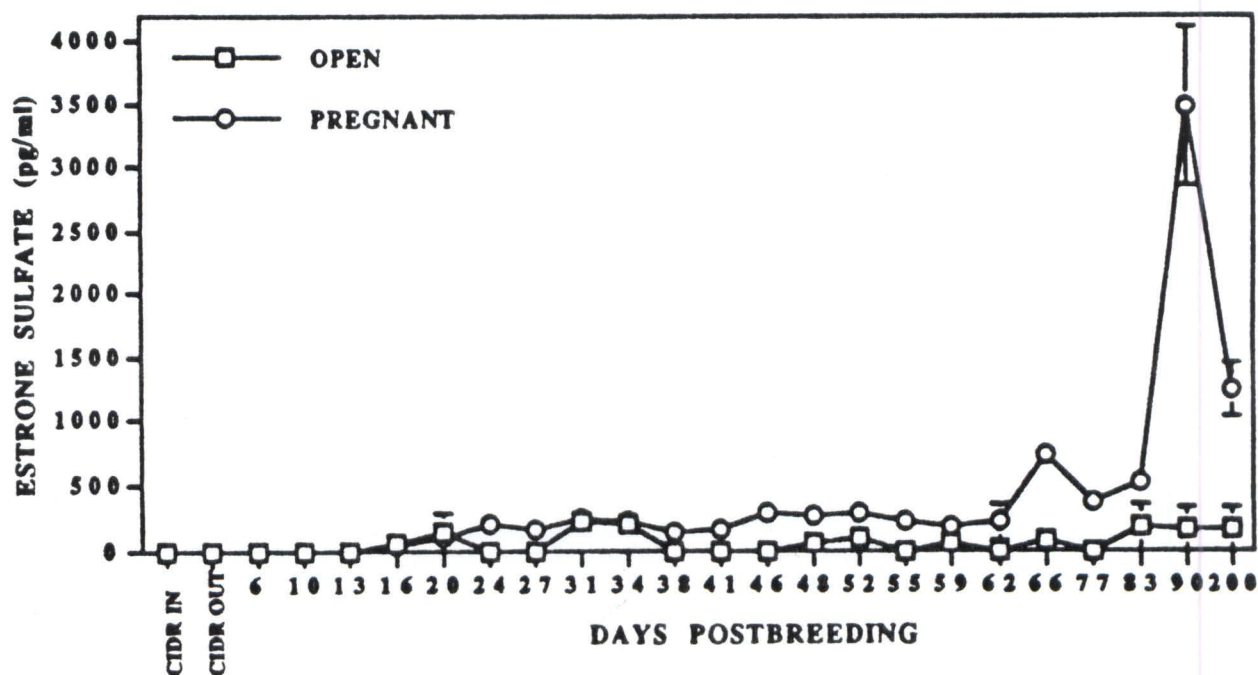


Figure 4. Serum estrone sulfate in pregnant (n=5) and open (n=2) fallow does following estrous synchronized natural matings



gland, is used by many researchers as a means for identifying whether an animal has been under some degree of stress. We decided to examine whether repeated handling may detrimentally affect pregnancy status and whether repeated handling would acclimate does to routine working conditions. Fallow does were estrous synchronized, separated into groups and bred to a natural sire. One group (n=10 does) was followed for 66 days with samples taken twice weekly, and a second group (n=20 does) was followed for 200 days with samples taken at weekly intervals. Repeated working consisted of bringing the animals from the pastures to the handling bar where they were weighed, restrained in a drop-floor chute, blood samples taken and the does released to their pastures. Our results indicated that while cortisol concentrations changed over time, there was no stable trend indicating the does became "less stressed" at the end of the studies relative to the beginning of the studies with regard to cortisol concentrations, although it should be noted that cortisol concentrations at day 200 were lower than at implant removal. One unexpected finding was that pregnant does had higher cortisol concentrations than open does (Figure 5).

These results indicate that cortisol may play an important role in the metabolism and maintenance of pregnancy in fallow does. It also suggests that cortisol might be used as an alternative method for pregnancy detection, provided it is used in conjunction with some other diagnostic test, such as progesterone, estrone sulfate, PSPB or ultrasonography. The implications of these findings require further study and are currently under investigation in our laboratory. Another important factor of these results is that cortisol can no longer be used in female fallow deer as an indicator of stress unless the reproductive state of the doe has been determined and specifically defined. This may be important as animal welfare concerns and a means for identifying the state of an animal's well-being becomes an issue for deer farmers maintaining large herds in intensive farming operations.

Application/Recommendations. The reproductive performance of female cervidae in intensive farming or ranching operations may be affected by a number of environmental and managerial factors. Age, body weight, body condition, previous reproductive performance, method of breeding and the efficiency of handling facilities may all affect the ability of a doe to become pregnant and carry the fawn to term. Through careful monitoring of farm records, providing an adequate nutritional plane and utilizing safe and effective handling procedures, producers may enhance the reproductive performance of their herd and thus maximize its production potential.

Studies at the Texas A&M University Agricultural Research and Extension Center at Overton and in cooperation with several deer producers in Texas will continue to investigate the

environmental and nutritional interactions associated with the reproductive biology of various agriculturally important species of deer.

Figure 5. Serum cortisol in pregnant (n=20) and open (n=3) fallow does following estrous synchronized natural matings

