BLOOD CHEMISTRY OF FREE-RANGING AND CAPTIVE WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*) IN TEXAS

A Thesis

by

MELANIE LOVE SMITH

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

May 2011

Major Subject: Veterinary Microbiology

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Approved by:

Co-Chairs of Committee, Donald Davis
Charles Long
Committee Members, Alfonso Clavijo
Leon Russell
Head of Department, Linda Logan

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ABSTRACT

Blood Chemistry of Free-Ranging and Captive White-tailed Deer (*Odocoileus virginianus*) in Texas. (May 2011)

Melanie Love Smith, B.S., Texas A&M University

Co-Chairs of Advisory Committee: Dr. Donald S. Davis
Dr. Charles Long

Blood samples were collected from 602 white-tailed deer (WTD) (*Odocoileus virginianus*) between October 2008 – October 2009, from 15 different counties throughout Texas. White-tailed deer were evaluated for serum biochemical parameters (total protein, albumin, calcium serum, phosphorus, glucose, blood urea nitrogen, creatinine, total bilirubin, creatine kinase, aspartate aminotransferase, glutamic-oxaloacetic transaminase, globulins, albumins to globulins ratio, gamma-glutamyl transferase, and magnesium) and the following variables were recorded: age, gender, county of collection, season, capture method, and status based on captive or free-ranging. The 14 biochemical parameters were compared for WTD among age groups fawns (<12 months), yearlings (≥12 months - <24 months) and adults (≥24 months), gender, season (Spring, Summer, Fall and Winter), status (captive or free-ranging) and capture method (physical restraint, anesthetized using physical restraint method of drug administration, anesthetized using dart gun method of drug administration, drop-netted, net-gunned, or hunter harvested). The data collected for these parameters was used to establish normal ranges for a comprehensive metabolic panel (serum chemistry panel) for WTD in Texas. These reference ranges will be used for both captive and free-ranging WTD to improve diagnostic screening and disease monitoring.

Captive vs. free-ranging status was statistically significant in WTD for 7 of the 14 physiological parameters. Significant differences and trends were observed among the three age groups. Calcium and phosphorus had an inverse relationship with age, while glucose had a direct relationship with age. Gender was statistically significant for 7 of 14 parameters. Anesthetized WTD vs. non-anesthetized had the greatest impact on mean blood chemistry values. Values for total serum protein, albumin, calcium, phosphorus, and globulins were higher for non-anesthetized WTD. Glucose, BUN, and AST mean values for higher for anesthetized WTD.

DEDICATION

This thesis is dedicated to my loving and supportive family.

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I would like to thank my committee members, Dr. Alfonso Clavijo, Dr. Donald S. Davis, Dr. Charles Long, and Dr. Leon Russell, for their support and guidance throughout the course of this research.

I would also like to thank the Texas Deer Association (TDA) and its members for their overall contribution and involvement to this project. Without the TDA, this project would not have been possible. I also thank Texas Parks and Wildlife for their support and enabling collection of multiple samples. Additional financial support was provided by the Texas A&M University Department of Veterinary Pathobiology Graduate Teaching Assistantship, the Texas A&M University College of Veterinary Medicine scholarship, and the Texas Deer Association scholarships. Numerous individuals contributed many hours to this project, however Warren Bluntzer, James Bonds, Dr. Tammy Beckham, Dr. Dick Cain, Ross Eckhardt (Big Rack Ranch), and Chris McDaniel (Triple JJJ Ranch) were monumental in the success of collection sites, sample collection, data analysis, and data distribution.

NOMENCLATURE

A/G Ratio	Albumin to Globulin Ratio
AST	Aspartate Aminotransferase
BUN	Blood Urea Nitrogen
CK	Creatine Kinase
GGT	Gamma-glutamyltransferase
TSP	Total Serum Protein
WTD	White-tailed Deer

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1. INTRODUCTION

White-tailed deer (WTD) have a significant impact on the Texas economy annually through breeding and hunting operations. Anderson et al. (2007) found that during 2007, the total economic contribution in Texas was over 652 million dollars. With over 100,000 WTD currently being raised in captive breeding operations, there is a demand for increased routine veterinary care, diagnostics and disease surveillance. Little work has been conducted in captive WTD in Texas, and diagnostic laboratories and veterinarians are lacking reference ranges for comprehensive metabolic panel.

The Research Committee and the Animal Health Committee of the Texas Deer Association identified the need for improved diagnostics in 2008 at their annual convention. Accurate diagnosis and treatment in WTD has been impaired because of the lack of appropriate reference data. Some limited research has been conducted on blood parameters in WTD in Texas. Blood characteristics have been examined for free-ranging WTD in Texas; however, they have not been evaluated for both captive and free-ranging WTD simultaneously, over the course of a year and a large geographic area. White and Cook (1974) analyzed blood characteristics of 31 newborn fawns and 79 older WTD from two South Texas free-ranging populations.

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This thesis follows the style of Journal of Wildlife Diseases.

White and Cook reported that more data was needed from free-ranging populations to determine which blood composition characteristics could be used efficiently to indicate subtle differences in the health and condition of deer. Blankenship and Varner (1979) conducted extensive research analyzing blood parameters in WTD from 1974-1979 in order to determine animal condition. They looked at 267 free-ranging, hunter-harvested or chemically immobilized deer. Other variables that Blankenship and Varner recorded were location of kill, age class, season, reproductive status, stress factors and blood condition. Considering these variables, it was discovered that stress factors, blood condition, and degree of hemolysis, caused the greatest variation in blood chemistry. Waid and Warren (1984) described seasonal variations in physiological indices of 86 adult, free-ranging does from the Edwards Plateau region of Texas. Six components of the blood serum did not have seasonal variation, while 12 parameters did have seasonal variation.

Information regarding the blood parameters was provided by Roche Diagnostics and is located in the appendix on page 37. Evaluation of blood chemistry is a simple and practical diagnostic technique that is commonly used for many species. In the wild, WTD are prey animals and therefore they do not show many signs or symptoms of illness. Like free-ranging WTD, captive WTD rarely exhibit symptoms. More tools are needed to be able to identify and treat disease in WTD. Blood chemistry reference interval for free-ranging and captive WTD will allow for preventative medicine, routine health assessment of valuable animals, nutritional status of WTD, and will highlight differences in individual WTD.

In addition to seasonal variations, more knowledge of additional factors is needed to further improve diagnostics. The variables that were accounted for in this study were gender, age grouped by fawns (<12 months), yearlings (≥12 months - <24 months) and adults (≥24 months), season (Spring, Summer, Fall and Winter), status (captive or free-ranging) and capture method (physical restraint, anesthetized using physical restraint method of drug administration, anesthetized using dart gun method of drug administration, drop-netted, net-gunned, or hunter harvested).

The purpose of this study is to establish a normal reference range for 14 serum chemistry parameters of WTD over the course of 12 months, taking into account captive or free-ranging status, gender, age, season, and capture method. Knowing these parameters will help to improve diagnostics and health evaluations specifically for WTD.

2. MATERIALS AND METHODS

2.1 Sample Population

Starting October 2008, this study was conducted in 15 different counties throughout the State of Texas. The Kerr WMA in Kerr County, private ranches, and residential areas were used as collection sites in following counties: Brazos, Burleson, Erath, Hunt, Kaufman, Kerr, Kimble, Lampasas, Live Oak, Llano, Montague, Montgomery, Webb, Williamson and Wise. Blood was collected from 433 captive and 168 free-ranging deer from October 2008-October 2009. Of the 433 captive deer, 198 were bucks and 235 were does ranging in age from less than 1 year old (fawn) to 7 years old. The free-ranging deer consisted of 60 bucks and 108 does ranging in age from less than one year old to 6 years old. White-tailed deer were sampled by using six different capture methods: physical restraint (n=253), chemical immobilization using physical restraint method of drug administration (n=149), chemical immobilization using dart-gun method of drug administration (n=31), netted by a drop net (n=98), netted using a net gun from a helicopter (n=56), and hunter harvest (n=14).

Seasons were based on data received from the United States Naval Meteorology and Naval Observatory. The seasons started on the following dates: September 22, 2008 (fall), December 21, 2008 (winter), March 20, 2009 (spring) and June 21, 2009 (summer). In addition to seasons, physiological indices were examined by month.

White-tailed deer were placed in one of three age groups. Age for free-ranging WTD was determined by tooth eruption and tooth wear techniques described by Severinghaus (1949). Captive WTD age was determined from birthing records. White and Cook (1974) found that there were no significant differences among age groups of newborn fawns, therefore we placed all deer <12 months in the fawn class. Yearlings were classified as ≥ 12 months - < 24 months. Adults were classified as ≥ 24 months.

2.2 Sample Collection and Preparation

It is recommended that food and water be withheld prior to sample collection for a blood chemistry profile. Both of these can alter the results. The captive animals in the study did not have food or water withheld, due to the fact that this could not be controlled in free-ranging animals. Blood samples were obtained from live WTD via jugular venapuncture within 10 minutes of the animals being captured. Hunter harvested WTD samples were collected from the heart of the animal post-mortem. Animals that were net gunned from a helicopter were transported via vehicle to a base site where samples were collected via jugular vein. All other samples were taken from the animal where it was initially restrained via jugular vein.

Blood sampling was standardized as much as possible given the field conditions. Blood was collected using a 16 gauge needle and 20ml or 10ml syringe. Blood was then transferred from the syringe to a 9ml Kendall Corvac™ serum separator tube. Samples were allowed to cool to room temperature for 30-45 minutes and then placed in an ice chest, until they could be transferred to a refrigerator. Blood samples were centrifuged 6-36 hours post collection and serum harvested. Serum was submitted to Texas Veterinary Medical Diagnostic Laboratory (TVMDL) (1 Sippel Road College Station, TX 77843).

The centrifuge protocol used to separate the serum required that Corvac serum separator containers be centrifuged for 10 minutes at 2000 RPMs. The temperature was 26°C with zero temperature compensation.

2.3 Blood Chemistry Analysis

All analyses for the small ruminant blood chemistry panel were performed at TVMDL using a Roche Modular-P ISE 1800 Chemical Chemistry and Immunological Machine (Roche Diagnostics Corporation, Indianapolis, Indiana, USA). TVMDL runs controls on this machine daily.

The following information regarding test reagents and imprecision was obtained from the Roche manual (Roche Diagnostics, Indianapolis, Indiana, USA). Imprecision was determined from analyzing a control serum three times. The total standard deviation (SD) and the total coefficient of variation (CV) are given for each test below.
The method for determining total protein is a colorimetric assay starting with a blank reagent and adding biuret reagent. The color intensity from the chemical reaction is directly proportional to the protein concentration which can be determined

photometrically. As for imprecision, three groups (n=63) were run using control sera, and the within run SD was 0.02-0.05 and the total CV was 1.1% for all three. Method comparison bias was determined to be 0.0018 at 4.8 g/dL and -0.038 at 8.0g/dL based on n=98. Using bromocresol green at a pH of 4.1, albumin can be determined photometrically. Imprecision based on three groups of n=63 gave a total CV 0.9%-1.3% and a total SD of 0.04-0.05. Calcium is measured photometrically after it reacts with o-cresolphthalein complexone in the presence of 8-hydroxyquinoline to form a purple chromophore. For the Roche/Hitachi Modular analytics p module, imprecision based on n=63 for three groups with control sera gave a total SD 0.156-0.236 and total CV 1.7%-2.0%. Phosphorus is determined photometrically in the ultraviolet region (340nm) after the addition of reagent blank and phosphate reagent. The imprecision with this test was determined by using three control groups n=63. The total SD was 0.059-0.150 and total CV was 1.5%-2.3%. After the addition of reagent 1 (buffer/ATP/NADP) and reagent 2 (HK/G-6-PDH), glucose can be determined photomertically. Based on 3 control runs n=63, total SD 2.39-4.89 and total CV 2.0%-2.2%. After the addition of reagent 1 (buffer/NADH) and reagent 2 (buffer/enzymes/substrate), urea is measured kinetically. Imprecision based on 3 control runs with n=63 resulted in total SD 0.50-0.77 and total CV 1.2%-3.5%. Creatinine is measured photometrically after addition of two reagents (buffer/enzymes/HTIB and buffer/enzymes/4-aminophenazone). Imprecision based on 3 control runs with n=63 resulted in total SD 0.019-0.0.035 and total CV 0.9%-2.3%. Total Bilirubin is determined photometrically after the addition of reagent 1 (buffer/solubilizer) and reagent 2 (diazonium ion). Imprecision based on 3 control runs with n=63 resulted in total SD 0.024-0.108 and total CV 2.2%-18.4%. Creatine Kinase is determined using a UV test and the addition of reagents (buffer/enzymes/coenzymes and buffer/substrate). The photometrically measured rate of formation of NADPH is directly proportional to the CK activity. Imprecision based on 3 control runs with n=63 resulted in total SD 1. 0-5.8 and total CV 0.6%-1.6%. The amount of aspartate aminotransferase is determined photometrically. Imprecision based on 3 control runs with n=63 resulted in total SD 1.25-1.97 and total CV 1.5%-2.1%. Gamma-glutamyltransferase (GGT) is determined by changes in absorbance measurements by the computer. Imprecision measurements were determined by running 3 controls with n=63. The resulting SD was 1.0-2.5 and the total CV was 1.3%-2.5%. Magnesium levels are determined by the following procedure: in alkaline solution, magnesium forms a purple complex with xylidyl blue. The magnesium concentration is measured photometrically via the decrease in the xylidyl blue absorbance. Imprecision was based on 3 control runs with n=63. The total SD was 0.013-0.046 and the total CV was 1.5%-2.4%.

2.4 Statistical Analysis

All parameters included in the blood chemistry panel on WTD in the present study were evaluated using statistical evaluation. The data was entered into a computer spreadsheet. Data was entered based on County of collection, date based on a number system according to season (spring, summer, fall or winter), animal ID, and gender, captive or free-ranging status, and age was entered using a numbering system. This spreadsheet was modified into a compatible format, comma delimited, for the statistical program to recognize. Statistical analysis was performed using the STATA 11.0 software (STATA, 2009, StataCorp LP, College Station, Texas 77845, USA). Statistical significance for the following was based on $P<0.05$. Blankenship and Varner (1979) discovered that hemolysis of the blood is one of the greatest sources of variation and will affect a number of the parameters in the blood, therefore, samples that were 2+, 3+, and 4+ hemolyzed were excluded (n=28) from the study to decrease variation. Also, according to the report from TVMDL, samples submitted on a clot will yield some false results (both high and low.) Therefore, samples submitted on are clot were excluded (n=7). Four animals were excluded due to incomplete information regarding age or incomplete results.

STATA was used to perform a manual stepwise regression analysis on the biological effects of season, captive vs. free-ranging status, capture method and age group for the biochemical parameter of interest from the blood chemistry panel. A final model was determined based on a significance level of $P<0.05$. The statistically significant biological parameters were individually evaluated for mean, standard deviation, and range for each of the 14 biochemical parameters included in the blood chemistry panel. STATA was also used to determine a descriptive model of the blood chemistry parameters by generating the mean, standard deviation, and range for different variables. These results were used to establish a diagnostic reference range for WTD.

In free-ranging deer, Blankenship and Varner (1979) found that stress is one of the greatest factors affecting blood chemistry, and therefore stress needed to be eliminated or reduced as much as possible. The captive deer in this study were only handled via physical restraint or anesthetization, the two most common methods of restraint. In the captive deer industry, producers have methods that help reduce stress. Some of those methods include working deer in climate controlled environments, working deer in dark handling facilities, and covering the deer's eyes with a blind fold. Handling techniques and capture methods were not standardized and vary among groups.

3. RESULTS

The reference interval for captive and free-ranging WTD appears in Table 1 and is compared to domestic livestock (cattle, sheep, and goats) reference intervals currently used by TVMDL. The reference interval for WTD in Table 1 was established using captive, physically restrained WTD (n=244) and free-ranging WTD captured by drop net (n=90). Captive and free-ranging WTD had significantly different ($P<.05$) ranges for the following 7 out of 14 components: calcium, glucose, BUN, creatinine, total bilirubin, AST, and magnesium. Out of these 7 significant components, 4 mean values are higher in captive WTD than free-ranging WTD shown respectively as follows: glucose (116.5 mg/dl vs. 96.5 mg/dl), BUN (29.6 mg/dl vs. 17.8 mg/dl), total bilirubin (0.3 mg/dl vs. 0.2 mg/dl), and AST (140.3 mg/dl vs. 124.4 mg/dl). Free-ranging WTD had significantly higher means for the following: calcium (10.2 mg/dl vs. 9.5mg/dl), creatinine (1.8 mg/dl vs. 1.3 mg/dl), and magnesium (2.5 mg/dl vs. 2.0mg/dl).

Captive WTD ranges for albumin, calcium, total bilirubin, GGT, and magnesium fall within at least one of the domestic livestock ranges. Out of these 5 components for captive WTD, all 5 are within the reference range for a goat. Free-ranging WTD reference ranges also fall within the same domestic livestock reference ranges mentioned above for captive WTD, however A/G ratio for free-ranging WTD also falls with domestic livestock ranges. Both globulins and A/G ratio reference range for free-ranging WTD falls within the range for cattle.

TABLE 1: Mean concentration ± two standard deviations for blood chemistry components in WTD and reference ranges for traditional livestock

Component[a]	Captive WTD[b]	Free-Ranging WTD[c]	Goat	Sheep	Cattle
TSP(g/dl)	5.8-9.2	6.1-8.9	4.8-8.8	6.0-8.6	6.2-9.3
Albumin (g/dl)	2.7-4.1	2.8-4.0	2.0-4.4	3.1-5.0	3-4.6
Calcium (mg/dl)	8.0-11.0	8.7-11.7	7.5-11.9	8.7-12.4	8.3-10.4
Phosphorus (mg/dl)	4.5-13.7	6.2-12.8	2.9-11.7	4.9-11.7	4.9-9.1
Glucose (mg/dl)	18.6-214.4	20.2-172.8	26-126	58-109	31-77
BUN (mg/dl)	14.7-44.5	4.6-31.0	17-31	12.0-32	10.0-25
Creatinine (mg/dl)	0.5-2.1	1.1-2.3	0.4-1.2	0.3-1.3	0.5-1.7
Total Bilirubin (mg/dl)	<0.7	<0.6	<0.7	<0.3	0.1-0.5
Creatine Kinase (mg/dl)	<3954.8	<2001.7	<779	15-213	77-265
AST (SGOT) (mg/dl)	28.6-252.0	52.6-196.2	32-152	51-130	47-138
Globulins (mg/dl)	2.3-5.9	2.8-5.4	1.7-5.5	2.1-4.4	2.5-6.1
A/G Ratio (mg/dl)	0.5-1.3	0.6-1.2	0.8-1.7	0.8-1.7	0.6-1.5
GGT (mg/dl)	<203	4.4-110.8	<319	34-62	11.0-39
Magnesium (mg/dl)	1.5-2.5	1.9-5.9	1.29-2.77	1.7-2.8	1.5-2.5

[a] TSP= total serum protein; BUN= blood urea nitrogen; AST= aspartate aminotransferase; A/G ratio= albumins to globulins ratio; GGT= gamma-glutamyl transferase
[b] values for captive WTD were animals that were captured by physical restraint (n=244)
[c] values for free- ranging WTD captured by drop-net (n=90)
[d]Traditional livestock reference ranges from Texas Veterinary Medical Diagnostic Laboratory

Mean blood chemistry values, standard deviations, ranges and p-values for captive, anesthetized (n=145) and non-anesthetized (n=244) WTD are given in Table 2. Anesthesia had a significant effect on the majority of the blood chemistry components. Eleven of the 14 blood chemistry components are statistically significant when comparing anesthetized WTD to non-anesthetized WTD. Out of the 11 significant blood chemistry components, 6 were higher for non-anesthetized WTD (total serum protein, albumin, calcium, phosphorus, and globulins), 3 were higher for anesthetized WTD (glucose, BUN, and AST), and 2 appear very similar among both groups (creatinine and A/G ratio). Glucose has the largest and most noticeable increase in anesthetized WTD

(224.5 mg/dl) compared to non-anesthetized WTD (116.4 mg/dl). Aspartate aminotransferase also has a large increase in anesthetized WTD (181.0 mg/dl) compared to non-anesthetized WTD (140.3 mg/dl).

Captive and free-ranging WTD are compared by gender in Table 3. Captive males (n=168) and captive females (n=76) were all handled through physical restraint. Free-ranging males (n=44) and females (n=46) were all captured by drop net. In captive WTD, males had higher values than females for the following (shown respectively): total serum protein (7.7 mg/dl vs. 7.0 mg/dl), glucose (124.0 mg/dl vs. 100.0 mg/dl), creatinine (1.4 mg/dl vs. 1.1 mg/dl), CK (995.6 mg/dl vs. 649.7mg/dl), AST (144.3 mg/dl vs. 131.6 mg/dl), globulins (4.3 mg/dl vs. 3.7 mg/dl), and GGT (60.9 mg/dl vs. 72.9 mg/dl). Five of the seven noticeable differences are significant ($P<.05$). All of these values are higher for males except GGT. Free-ranging WTD have the opposite gender differences for their mean values. Glucose and creatine kinase are higher in females, while GGT is lower in females.

TABLE 2: Mean blood chemistry concentration ± one standard deviation (SD), P-values, and ranges for non-anesthetized and anesthetized captive WTD in Texas.

	Mean ± SD			Range	
Component[a]	Non-anesthetized[b]	Anesthetized[c]	P-value	Non-anesthetized	Anesthetized
TSP (g/dl)	7.5 ± 0.86	6.7 ± 0.43	0.000	5.8-10.5	5.7-8.1
Albumin (g/dl)	3.4 ± 0.35	3.2 ± 0.22	0.000	1.9-4.2	2.5-3.6
Calcium (mg/dl)	9.5 ± 0.76	9.0 ± 0.76	0.000	6.4-12.1	7.3-12.1
Phosphorus (mg/dl)	9.1 ± 2.23	5.7 ± 1.70	0.000	3.14-18.5	1.9-12.5
Glucose (mg/dl)	116.5 ± 48.93	224.5 ± 80.28	0.000	26.0-290.0	56.0-423.0
BUN (mg/dl)	29.6 ± 7.47	32.1 ± 8.00	0.002	11.9-56.6	13.0-69.2
Creatinine (mg/dl)	1.3 ± 0.38	1.3 ± 0.29	0.053	0.7-2.6	0.6-2.4
T. Bilirubin (mg/dl)	0.3 ± 0.20	0.3 ± 0.19	0.039	0.1-1.2	0.1-1.3
CK (mg/dl)	887.9 ± 1533.44	648.3 ± 640.70	0.074	10-21410.0	50.0-3911.0
AST (mg/dl)	140.3 ± 55.83	181.0 ± 114.00	0.000	11.0-602.0	76.0-626.0
Globulins (mg/dl)	4.1 ± 0.88	3.5 ± 0.50	0.000	2.5-8.6	2.5-5.2
A/G Ratio (mg/dl)	0.9 ± 0.20	0.9 ± 0.16	0.003	0.22-1.4	0.5-1.4
GGT (mg/dl)	64.6 ± 69.20	65.4 ± 26.80	0.898	12.2-1093.5	13.0-232.0
Magnesium (mg/dl)	2 ± 0.23	1.9 ± 0.19	0.000	1.5-3.3	1.4-2.5

[a] TSP= total serum protein; BUN= blood urea nitrogen; AST= aspartate aminotransferase; A/G ratio= albumins to globulins ratio;
GGT= gamma-glutamyl transferase; CK= creatine kinase
[b]values for non-anesthetized captive WTD captured by physical restraint (n=244)
[c]values for anesthetized captive WTD were administered xylazine by physical restraint method of drug administration (n=145)

TABLE 3: Mean concentration ± one standard deviation (SD) for captive and free-ranging WTD of both genders.

Component[a] (units)	Gender[b]	mean ± SD	Range	mean ± SD	Range
		Captive[c]		Free-Ranging[d]	
Total Serum Protein (g/dl)	M	7.7 ± 0.87	5.8-10.5	7.5 ± 0.79	6.2-9.7
	F	7.0 ± 0.64	5.8-8.8	7.5 ± 0.65	6.2-8.9
Albumin (g/dl)	M	3.4 ± 0.38	1.9-4.2	3.5 ± 0.30	2.3-4.1
	F	3.4 ± 0.27	2.6-3.9	3.4 ± 0.27	2.6-3.8
Calcium, serum (mg/dl)	M	9.4 ± 0.79	7.8-12.1	10.2 ± 0.79	8.6-12.3
	F	9.5 ± 0.68	6.4-10.9	10.3 ± 0.76	9.0-12.0
Phosphorus, serum (mg/dl)	M	9.1 ± 2.26	3.1-18.5	9.6 ± 1.62	5.4-12.8
	F	9.1 ± 2.32	4.8-14.8	9.4 ± 1.74	6.0-13.6
Glucose (mg/dl)	M	124.0 ± 52.48	36.0-290.0	92.7 ± 31.34	51.0-184.0
	F	100.0 ± 35.1	26.0-223.0	100.1 ± 43.75	33.0-191.0
Blood Urea Nitrogen (mg/dl)	M	29.6 ± 7.94	11.9-56.6	17.0 ± 6.21	5.7-30.8
	F	29.4 ± 6.35	17.9-42.4	18.6 ± 6.97	6.5-35.4
Creatinine (mg/dl)	M	1.4 ± 0.40	0.7-2.6	1.8 ± 0.32	1.2-2.5
	F	1.1 ± 0.23	0.7-1.89	1.7 ± 0.31	1.2-2.3
Total Bilirubin (mg/dl)	M	0.3 ± 0.19	0.1-1.2	0.2 ± 0.25	0.1-1.76
	F	0.4 ± 0.22	0.1-1.2	0.2 ± 0.09	0.1-0.5
Creatine Kinase (mg/dl)	M	995.6 ± 1807.76	135.0-21410.0	648.7 ± 346.65	67-1521
	F	649.7 ± 508.42	10.0-2469.0	821.5 ± 822.20	192-4284
AST (SGOT) (mg/dl)	M	144.3 ± 61.37	11-602	123.9 ± 26.69	73-191
	F	131.6 ± 40.0	65-299	124.9 ± 43.19	79-292
Globulins (mg/dl)	M	4.3 ± 0.91	2.6-8.6	4.0 ± 0.74	2.9-6.7
	F	3.7 ± 0.64	2.5-5.5	4.1 ± 0.58	2.8-5.4
A/G Ratio (mg/dl)	M	0.8 ± 0.20	0.2-1.4	0.9 ± 0.16	0.5-1.2
	F	0.9 ± 0.18	0.5-1.3	0.9 ± 0.14	0.6-1.3
GGT (mg/dl)	M	60.9 ± 21.79	12.2-177.6	59.2 ± 32.95	33-234
	F	72.9 ± 119.8	13.4-1093.5	56.0 ± 18.95	27-143
Magnesium, serum (mg/dl)	M	2.0 ± 0.25	1.5-3.3	2.5 ± 0.28	1.9-3.2
	F	1.9 ± 0.18	1.6-2.5	2.6 ± 0.26	2.1-3.2

[a] AST= aspartate aminotransferase; A/G ratio= albumins to globulins ratio; GGT= gamma-glutamyl transferase
[b]Bucks (M) and does (F) of all ages are included
[c]values for captive WTD were animals that were captured by physical restraint. Males (n=168) Female (n=76)
[d]values for free-ranging WTD were animals captured by drop net. Males (n=44) Female (n=46)

Table 4 compares mean values for each blood chemistry component by age group for both captive and free-ranging WTD. Captive WTD fawns (n=45), yearlings (n=94), and adults (n=105) were all physically restrained. Free-ranging WTD fawns (n=46), yearlings (n=7), and adults (n=37). In captive WTD, there are distinct direct and inverse age relationships for albumin, calcium, phosphorus, glucose, AST, and magnesium. Calcium and phosphorus mean concentrations are highest in fawns, while mean concentrations for albumin, glucose, AST, and magnesium are lowest in fawns. Free-ranging WTD fawns have higher mean values than captive WTD for the following (shown respectively): TSP (7.5 mg/dl vs. 7.1 mg/dl), albumin (3.4 mg/dl vs. 3.1 mg/dl), calcium (10.7 mg/dl vs. 10.1 mg/dl), glucose (99.3 mg/dl vs. 98.7 mg/dl), creatinine (1.7 mg/dl vs. 1.3 mg/dl), creatinine kinase (859.1 mg/dl vs. 842.9 mg/dl), globulins (4.1 mg/dl vs. 4.0 mg/dl), A/G ratio (0.9 mg/dl vs. 0.8 mg/dl), and magnesium (2.5 mg/dl vs. 1.9 mg/dl).

Table 5 gives the mean concentration of each blood parameter ± one standard deviation and the range. These mean values include both captive and free-ranging deer of both genders, all ages, and different capture methods.

TABLE 4: Mean concentration ± one standard deviation (SD) for captive and free-ranging WTD among different age groups (fawns, yearlings, and adults).

Component[a] (units)	Age[b]	Captive[c] mean ± SD	Captive[c] Range	Free-Ranging[d] mean ± SD	Free-Ranging[d] Range
Total Serum Protein (g/dl)	F	7.1 ± 0.66	5.8-8.5	7.5 ± 0.79	6.2-9.7
	Y	7.0 ± 0.61	5.8-8.5	7.2 ± 0.15	6.9-7.3
	A	8.1 ± 0.78	6.6-10.5	7.6 ± 0.67	6.2-8.9
Albumin (g/dl)	F	3.1 ± 0.37	2.4-3.9	3.4 ± 0.32	2.3-4.1
	Y	3.4 ± 0.27	2.6-4.1	3.4 ± 0.26	3.0-3.8
	A	3.5 ± 0.34	1.9-4.2	3.5 ± 0.22	2.9-3.8
Calcium (mg/dl)	F	10.1 ± 0.56	9.2-12.1	10.7 ± 0.56	9.6-12.3
	Y	9.6 ± 0.59	7.8-10.9	9.6 ± 0.62	8.9-10.3
	A	9.0 ± 0.70	6.4-10.5	9.9 ± 0.73	8.6-12.0
Phosphorus (mg/dl)	F	10.9 ± 1.94	7.3-18.5	10.4 ± 1.40	7.9-13.6
	Y	9.1 ± 1.83	5.5-14.8	8.4 ± 1.58	5.4-9.8
	A	8.3 ± 2.33	3.1-13.7	8.5 ± 1.31	6.0-12.6
Glucose (mg/dl)	F	98.7 ± 48.51	33-236	99.3 ± 37.84	54-191
	Y	107.7 ± 38.53	26-290	97.7 ± 25.0	71-129
	A	132.1 ± 53.08	42-282	92.7 ± 41.02	33-183
BUN (mg/dl)	F	25.2 ± 4.53	15.8-37.3	17.5 ± 6.95	6.5-33.5
	Y	32.5 ± 8.90	17.5-56.6	18.3 ± 5.84	7.4-26.3
	A	28.8 ± 5.88	11.9-45.7	18.1 ± 6.49	5.7-35.4
Creatinine (mg/dl)	F	1.3 ± 0.21	0.8-1.8	1.7 ± 0.32	1.2-2.5
	Y	1.1 ± 0.20	0.7-1.7	1.8 ± 0.19	1.5-2.1
	A	1.6 ± 0.38	0.9-2.6	1.9 ± 0.29	1.3-2.4
T. Bilirubin (mg/dl)	F	0.3 ± 0.11	0.1-0.7	0.2 ± 0.25	0.1-1.8
	Y	0.4 ± 0.21	0.1-1.2	0.2 ± 0.12	0.1-0.4
	A	0.4 ± 0.21	0.1-1.2	0.2 ± 0.07	0.1-0.3
Creatine Kinase (mg/dl)	F	842.9 ± 455.63	240-2132	859.1 ± 747.93	67-4284
	Y	589.3 ± 439.45	135-2469	381.0 ± 244.90	192-853
	A	1174.5 ± 2251.52	10-21410	635.7 ± 466.12	198-2505
AST (mg/dl)	F	132.4 ± 37.20	81-299	131.5 ± 41.44	80-292
	Y	133.3 ± 36.82	65-308	135.3 ± 41.67	79-190
	A	150.0 ± 72.9	11-602	113.5 ± 23.2	73-184
Globulins (mg/dl)	F	4.0 ± 0.89	2.6-5.9	4.1 ± 0.72	2.9-6.7
	Y	3.6 ± 0.61	2.5-5.4	3.8 ± 0.21	3.5-4.1
	A	4.5 ± 0.88	2.8-8.6	4.1 ± 0.64	2.8-5.4
A/G Ratio (mg/dl)	F	0.8 ± 0.26	0.4-1.3	0.9 ± 0.15	0.5-1.2
	Y	0.9 ± 0.17	0.5-1.4	0.9 ± 0.12	0.8-1.1
	A	0.8 ± 0.17	0.2-1.2	0.9 ± 0.15	0.6-1.3
GGT (mg/dl)	F	77.9 ± 155.41	13.4-1093.5	56.8 ± 20.03	32-128
	Y	63.2 ± 18.38	15.3-114.0	70.4 ± 72.80	27-234
	A	60.2 ± 23.91	12.2-177.6	56.2 ± 18.22	34-143
Magnesium (mg/dl)	F	1.9 ± 0.23	1.6-2.5	2.5 ± 0.27	2.1-3.2
	Y	1.9 ± 0.20	1.5-2.4	2.3 ± 0.14	2.1-2.5
	A	2.0 ± 0.25	1.5-3.3	2.5 ± 0.29	1.9-2.5

[a] BUN=blood urea nitrogen; AST= aspartate aminotransferase; A/G ratio= albumins to globulins ratio; GGT= gamma-glutamyl transferase
[b] age groups are defined as follows: animals < 1 year old are fawns (F), animals ≥ 1 year old but < 2 years are yearlings (Y), and adults (A) ≥ 2 years.
c Captive WTD (n=244) were all physically restrained for the following ages: Fawn (n=45), Yearling (n=94), and adult (n=105).
d Free-ranging animals were all captured by drop-net (n=90) with the following age groups: Fawn (n=46), Yearling (n=7), and adult (n=37).

TABLE 5: Mean concentration ± one standard deviation (SD) for captive and free-ranging deer in Texas of both genders, all ages, and different capture methods (n=562).

Component (units)	Mean ± SD	Range
Total Serum Protein (g/dl)	7.2 ± 0.79	5.5-10.5
Albumin (g/dl)	3.3 ± 0.31	1.9-4.2
Calcium (mg/dl)	9.5 ± 0.99	6.4-13.5
Phosphorus (mg/dl)	8.2 ± 2.74	1.9-26.4
Glucose (mg/dl)	156.5 ± 86.44	26-771
Blood Urea Nitrogen (mg/dl)	27.3 ± 9.25	4.0-69.2
Creatinine (mg/dl)	1.4 ± 0.38	0.6-2.6
Total Bilirubin (mg/dl)	0.3 ± 0.20	0.1-1.76
Creatine Kinase (mg/dl)	778.6 ± 1138.84	10-21410
AST (SGOT) (mg/dl)	151.1 ± 89.71	11-1308
Globulins (mg/dl)	3.9 ± 0.77	2.2-8.6
A/G Ratio (mg/dl)	0.9 ± 0.19	0.2-1.5
GGT (mg/dl)	64.9 ± 53.31	12.2-1093.5
Magnesium (mg/dl)	2.1 ± 0.46	1.4-4.6

3.1 Total Serum Protein (TSP)

For TSP, capture method, gender, captive versus free-ranging status and age group were all significantly different. Bucks that were physically restrained had significantly higher means in their respective age groups than does as given in Appendix Table A-1. Deer that were anesthetized had lower mean TSP than those that were physically restrained, however not significantly lower. Highest TSP was found in adult bucks for both captive 8.205 g/dL and free-ranging 7.867 g/dL.

3.2 Albumin

Season, capture method, gender, status and age group were all statistically significant for albumin. Captive, physically restrained bucks and does of all three age groups had higher means in spring than fall (Appendix Table A-2).

3.3 Calcium

Capture method, status, and age group were all significantly different for the mean values of calcium. Results in Appendix Table A-3 show that calcium was highest in fawns for all capture methods and for both captive and free-ranging WTD with values ranging from 10.122 mg/dl to 10.667 mg/dl. An inverse relationship with age was observed for physically restrained WTD (fawns 10.122 mg/dL, yearlings 9.610 mg/dL, adults 9.022 mg/dL) and anesthetized WTD. Mean calcium values for WTD captured by nets had the highest levels in fawns, however didn't have an inverse relationship with age. Hunter harvested adult females had the highest mean value for calcium (10.780 mg/dL).

3.4 Phosphorus

Capture method, gender, status and age group were all significantly different for phosphorus (Appendix Table A-4). In this study, phosphorus follows the exact trend as calcium for capture method and age groups. Physically restrained and anesthetized WTD phosphorus values decreases significantly with age for the three different age groups demonstrating an inverse relationship with age. Animals captured by net had the highest mean values for fawns; however, they did not have an inverse relationship with age. The highest observed value (14.753 mg/dl) was observed in hunter-harvested, adult females. For animals that were both physically restrained and captured by drop net, does have higher means than bucks with one exception. The one exception was adult bucks that were physically restrained.

3.5 Glucose

Season, capture method, captive vs. free-ranging status, and age group were all statistically significant for glucose (Appendix Table A-5). Glucose levels were higher among all three age groups in the fall compared to spring for animals that were physically restrained. The lowest observed value for glucose was for yearling in the summer (79.913mg/dl). For animals captured by drop net, mean glucose values were higher in the winter than spring and fall. Animals that were net gunned during the winter had much higher glucose values (fawns 263.75mg/dL, yearlings 203.000mg/dL, and adults 238.875mg/dL) than those animals that were captured by drop net during the winter (fawns 109.263 mg/dL, yearlings 101.500 mg/dL, and adults 95.278 mg/dL).

3.6 Blood Urea Nitrogen (BUN)

Season, capture method and status were significantly different for BUN (Appendix Table A-6). Captive deer had higher means for BUN than free-ranging for every season and among every capture method. The highest value observed for BUN was in WTD anesthetized using the dart-gun method of drug administration during the fall (33.561 mg/dl). The lowest mean was for animals that were hunter harvested (10.720 mg/dl).

3.7 Creatinine

Gender, captive vs. free-ranging status, and age group were all statistically significant for creatinine (Appendix Table A-7). Captive and free-ranging bucks in each age group has higher mean values for creatine except for captive yearlings (bucks 1.111 mg/dl, does 1.165 mg/dl). Values for all captive deer (1.315mg/dl) are significantly lower than free-ranging deer (1.644 mg/dl).

3.8 Total Bilirubin

Season, status and age group were all statistically significant for total bilirubin (Appendix Table A-8). Captive and free-ranging WTD demonstrate dramatically different results and patterns for mean total bilirubin. Captive WTD values increase with age for all four seasons. Free-ranging WTD bilirubin values are lower in the fall and winter than during the spring.

3.9 Creatine Kinase

Season and gender were both statistically significant for creatine kinase (Appendix Table A-9). Bucks have higher creatine kinase than does during every season. Both bucks and does have the lowest values during the spring. Does had the highest amount of creatine kinase during the summer (822.13 U/l). No bucks were sampled during the summer season. The highest value for bucks was 1184.314 U/l during the fall.

3.10 Aspartate Aminotransferase (AST) (Glutamate oxalacetate transaminase)

Capture method and status were statistically significant for AST (Appendix Table A-10).

Values for all captive WTD were higher than free-ranging except for deer that were hunter-harvested, which had the highest value (293.000U/l). The lowest value was observed for free-ranging deer that were net-gunned from a helicopter (114.154 U/l).

3.11 Globulins

Capture method, gender, captive vs. free-ranging status, and age group were all statistically significant for globulins (Appendix Table A-11). For captive deer that were physically restrained, males had higher means than females for every age group. Free-ranging deer that were captured by drop net had higher mean values than WTD captured by net-guns. Anesthetized WTD had the lowest mean globulins for capture method.

3.12 Albumin to Globulin Ratio (A/G Ratio)

Season, gender, and age group were all statistically significant for A/G ratio (Appendix Table A-12). The highest observed value for bucks was in fawns during the fall (1.092 mg/dl). The highest observed value for does was in fawns during the winter (1.041 mg/dl). The lowest value was for buck fawns during the spring (0.713 mg/dl).

3.13 Gamma-glutamyltransferase (GGT)

Season and age group were both statistically significant for GGT (Appendix Table A-13). Fawns in the fall had the highest value, 99.216 mg/dl, and they had the largest range 13.4-1093.5 mg/dl. The second largest range was for adult WTD in the fall (12.2-232 mg/dl). The lowest observed values were in the spring (fawns 52.377 mg/dl and adults 50.139 mg/dl).

3.14 Magnesium

Season, capture method, gender, and status were statistically significant for magnesium (Appendix Table A-14). Values for bucks and does in each season were very close for every capture method except for WTD net-gunned in the fall. This difference could be due to the sample size (does n=33 and bucks n=5). Values were highest in the fall for every capture method.

4. DISCUSSION

Reference intervals for a blood chemistry panel are a particularly important tool for diagnosing disease, monitoring health status and body condition of captive WTD. Captive WTD are unique, non-traditional livestock animals that vary greatly from traditional livestock species. It is difficult to handle WTD for a prolonged period of time in order to run multiple tests or physical exams without causing the animal undue stress. A blood chemistry panel is a quick and simple diagnostic tool.

STATA was used to determine a descriptive model of the various components by generating the mean, standard deviation, and range for different variables. These results were used to establish a reference interval for WTD. Russell and Roussel (2007) stated that the reference interval is based on a large number of samples obtained from healthy animals (the reference population) and it is calculated theoretically to include 95% of the healthy population. They also state that it is generally recommended that at least 60 clinically healthy animals be used to establish a reference interval. This study included 602 apparently healthy individuals. Results from samples that were severely hemolyzed, submitted on a clot, or with incomplete results were excluded. The "captive" population analyzed consisted of 410 WTD that were captured by physical restraint or anesthetization. The "free-ranging" population (n=152) were WTD captured by drop-net, net gun, or hunter-harvest.

Due to laws imposed by the state of Texas to protect WTD, there are limited means to capture these animals. Commonly, captive WTD are handled by the three following means: physical restraint in conjunction with a handling facility, anesthetization by physical restraint method of drug administration, and anesthetization by dart gun method of drug administration. The three most common methods for handling free-ranging WTD are captured by drop net, captured by net-gun, and hunter harvested. Due to the capture methods, some comparisons could not be made. Physically restrained, captive WTD were compared to free-ranging WTD captured by drop-net. Drop-nets are remote activated to quietly drop on animals grazing beneath them. In this study, the ground crew quickly and safely removed the entangled WTD and placed it in a trailer. Net-gunned WTD in this study were chased by a helicopter until the animal was in an open area. White-tailed deer were then netted and left on the ground until a person came and removed them from the net and transported them to a central site. Animals that were net gunned during the winter had much higher glucose values (fawns 263.75mg/dL, yearlings 203.000mg/dL, and adults 238.875mg/dL) than those animals that were captured by drop net during the winter (fawns 109.263 mg/dL, yearlings 101.500 mg/dL, and adults 95.278 mg/dL) as shown in Appendix Table A-5. This could be due to the stress from the helicopter chase prior to animals being restrained. Due to the potential stress from the helicopter chase prior to being net-gunned, drop-netted deer were used to compare free-ranging WTD to captive WTD. Figure 1 shows the mean glucose values for captive and free-ranging deer by capture method. Glucose is highest in anesthetized

WTD and net-gunned WTD. Figure 2 gives the mean AST value for captive and free-ranging WTD based on capture method.

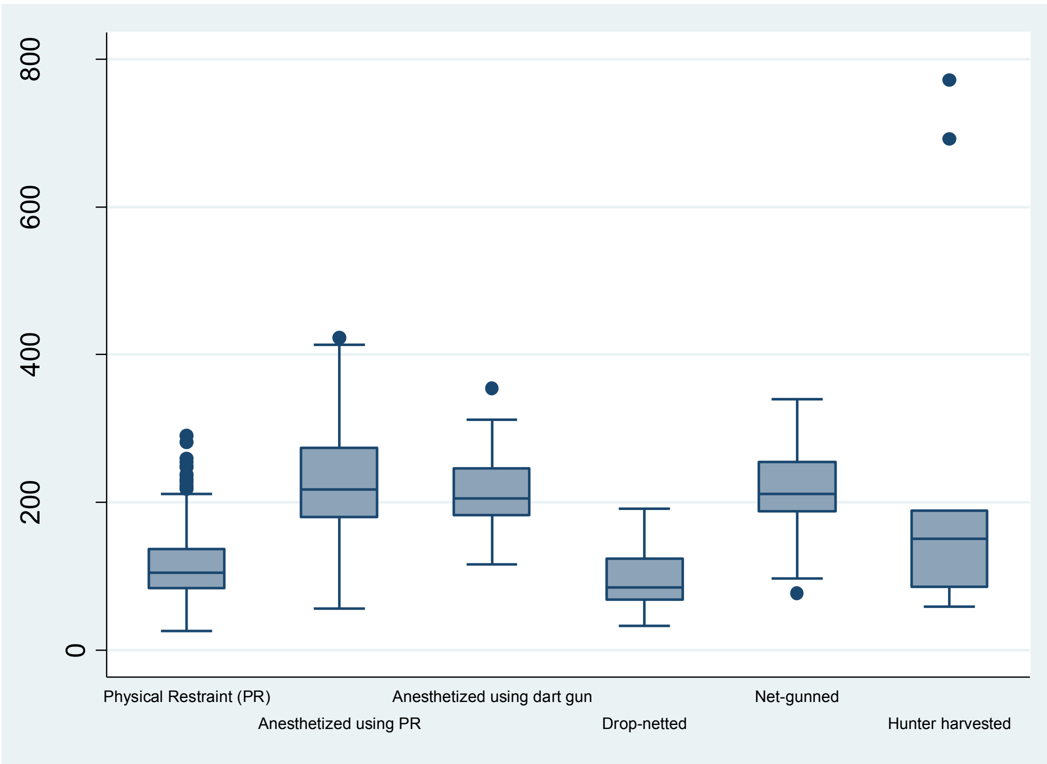

FIGURE 1: Mean glucose values of captive and free-ranging WTD based on capture method. Mean values for each capture method are based on the following sample sizes: Physical restraint (n=244), anesthetized using physical restraint (n=145), anesthetized using dart gun method of drug administration (n=21), drop netted (n=90), net-gunned from a helicopter (n=52), and hunter-harvested (n=10). Each capture method included males and females of all ages, sampled from October 2009-October 2010.

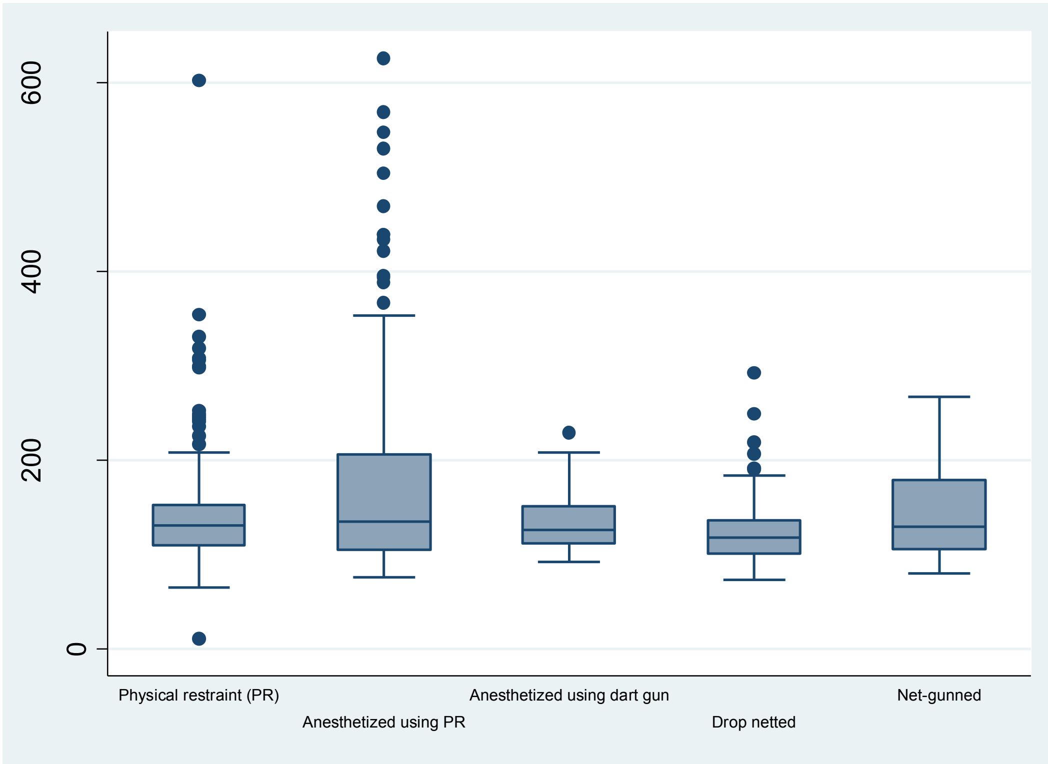

FIGURE 2: Mean AST values for captive and free-ranging WTD based on capture method. Mean values for each capture method are based on the following sample sizes: Physical restraint (n=244), anesthetized using physical restraint (n=145), anesthetized using dart gun method of drug administration (n=21), drop netted (n=90), and net-gunned from a helicopter (n=52). Each capture method included males and females of all ages, sampled from October 2009-October 2010.

Capture sites were located in 15 different counties throughout Texas. Numerous differences existed between WTD sample groups. Captive WTD were all fed a protein pellet diet, however the protein content ranged from 12%-20% depending on the herd. The fat content of the feed also varied from herd to herd depending on the season. Free-ranging WTD had the most diet variation. Some populations were supplemented a protein pellet, while some WTD were in over-populated areas without adequate nutrition. Other variations in this study were due to sample collection and handling.

Russell and Roussel (2007) state that it is imperative to remove the serum from the clot soon after collection (generally within 30 minutes), if accurate assessment of glucose is desired. There was a 6-36 hour range from the time blood was collected until centrifugation in this study.

In order to minimize variations, one person collected over 550 over the 602 WTD samples. All analysis was performed by the same TVMDL location. In order to maximally minimize variation, a large sample size was included, with multiple collections from some of the same capture sites. Blankenship and Varner (1979) noted that most of the significant variations in mean blood parameters related to age classes occurred after 8 years of age. In order to reduce variation, all of the deer involved in this study were 7 years old or younger.

4.1 White-tailed Deer Compared to Domestic Livestock

Table 1 lists the reference interval for WTD and domestic livestock. White-tailed deer cannot be compared to domestic livestock for diagnostic purposes because only 5 out of 14 ranges are similar. Captive vs. free-ranging status was statistically significant for 7 out of the 14 blood chemistry components. Due to the large sample size, WTD in this study should have a tighter reference interval than domestic livestock. However, WTD have a larger reference interval than domestic livestock for most of the parameters. Five of the captive WTD blood parameter ranges fell within established goat ranges. Free-ranging WTD also have 5 ranges within goat ranges, however also have two ranges that fall within cattle ranges. Neither captive nor free-ranging WTD can be compared to domestic livestock species due to high variability in blood chemistry means. Phosphorus, glucose, creatine kinase, AST mean values are higher in WTD than cattle, sheep, and goats. Russell and Roussel (2007) stated that glucose metabolism is unique in ruminants because they absorb essentially no preformed glucose from the gut and hyperglycemia occurs with stress (including excitement, fear, and severe pain). Glucose (mg/dl) reference intervals for WTD (18.6-214.4 mg/dl captive WTD) are greater and higher than domestic livestock (goats 26-126, sheep 58-109, cattle 31-77). Russell and Roussel (2007) also stated that creatinine is the result of normal muscle metabolism and is a product of the degradation of creatine, and that creatinine can be low in emaciated cattle with little muscle mass or on the high end of the reference interval in heavily muscled animals. They also stated that it is less influenced by extraneous factors. Creatinine is high in WTD (captive 0.5-2.1, free-ranging 1.1-2.3) compared to domestic livestock (goats 0.4-1.2, sheep 0.3-1.3, cattle 0.5-1.7).

4.2 Anesthetized vs. Non-Anesthetized

Eleven of the 14 blood chemistry components are statistically significant when comparing anesthetized WTD to non-anesthetized WTD (Table 2). Out of the 11 significant blood chemistry components, 6 were higher for non-anesthetized WTD (total serum protein, albumin, calcium, phosphorus, and globulins), 3 were higher for anesthetized WTD (glucose, BUN, and AST), and 2 appear very similar among both groups (creatinine and A/G ratio). Blankenship and Varner (1979) found that the stress factor that affected mean blood values for glucose and AST the most were because of stress from xylazine HCL. In this study, captive deer that were anesthetized using xylazine HCL had significantly higher mean blood values for glucose and AST than captive WTD that were not anesthetized. Deer in this study that were anesthetized had a mean blood glucose value of 224.5 mg/dl (n=145) compared to non-anesthetized deer 116.5 mg/dl (n=244). Blankenship and Varner (1979) found that anesthetized deer had a mean glucose value of 246.38 mg/dl (n=33) compared to non-anesthetized 115.53 mg/dl (n=234). The deer included in this study that were anesthetized had a mean AST value of 181.0 mg/dl (n=145) compared to non-anesthetized captive WTD 140.3 mg/dl (n=244). Blankenship and Varner (1979) found that anesthetized deer had a mean AST value of 285.38 mg/dl (n=33) compared to non-anesthetized 191.1 mg/dl (n=234). The values for glucose and AST in this study follow similar trends to Blankenship and Varner. Figure 3 has values for AST by capture method. Anesthetized WTD are have the highest mean and greatest variability.

4.3 Gender

Captive and free-ranging WTD are compared by gender in Table 3. Captive males, bucks, (n=168) and captive females, does, (n=76) were all captured by physical restraint. Free-ranging bucks (n=44) and does (n=46) were all captured by drop net. Captive WTD have different gender trends than free-ranging WTD. Free-ranging WTD mean values are very similar among bucks and does for the 14 blood chemistry components. Captive WTD mean values for each gender are noticeably different for total serum protein, glucose, creatinine, CK, AST, globulins, and GGT. Five of the seven noticeable differences are significant ($P<.05$). All of these values are higher for males except GGT. Free-ranging WTD have the opposite gender differences for their mean values. Glucose and creatine kinase are higher in females, while GGT is lower in females. Blankenship and Varner (1979) found that mean values were higher, but not significantly different for males for the following: albumin, protein, creatinine, and urea. In this study, males had significantly higher values for total serum protein, glucose, creatinine, total bilirubin, globulins, A/G ratio, and magnesium. Blankenship and Varner also found that glucose was significantly higher in males than females. This study found that glucose was significantly higher for males (124.0 mg/dl) than females (100.0 mg/dl) in captive WTD, however in free-ranging WTD mean glucose values for females (100.1 mg/dl) were higher than males (92.7mg/dl).

4.4 Age Group

Statistical descriptions of the means and standard deviations for all blood parameters are summarized in Table 3 according to age group. Work done by Anderson and Medin (1972) in *Odocoileus hemionus* deer (Mule deer) had higher calcium and phosphorus in younger age classes, but felt it was because of a few extreme values. Ages for captive WTD were known and accurate due to birthing records mandated by the state. Texas Parks and Wildlife has a unique number assigned to each captive WTD in Texas, and records have to be updated on an annual basis. Table 3 reveals significantly high values in captive WTD for calcium in fawns 10.1 mg/dl compared to 9.6 mg/dl in yearlings and

9.0 mg/dl in adults. Similarly, phosphorus in fawns is 10.9 mg/dl compared to yearlings 9.1 mg/dl and adults 8.3 mg/dl which also had a decline with increasing age group. The calcium and phosphorus relationship to age is given below in Figure 3. Albumin and glucose (Figure 4) had a significant increase with age. Blankenship and Varner (1979) found that glucose levels were significantly higher in young animals less than one year old. They also found that most of the significant variations in mean blood parameters related to age classes occurred after 8 years of age. All of the adult deer in this study were 2-7 years old.

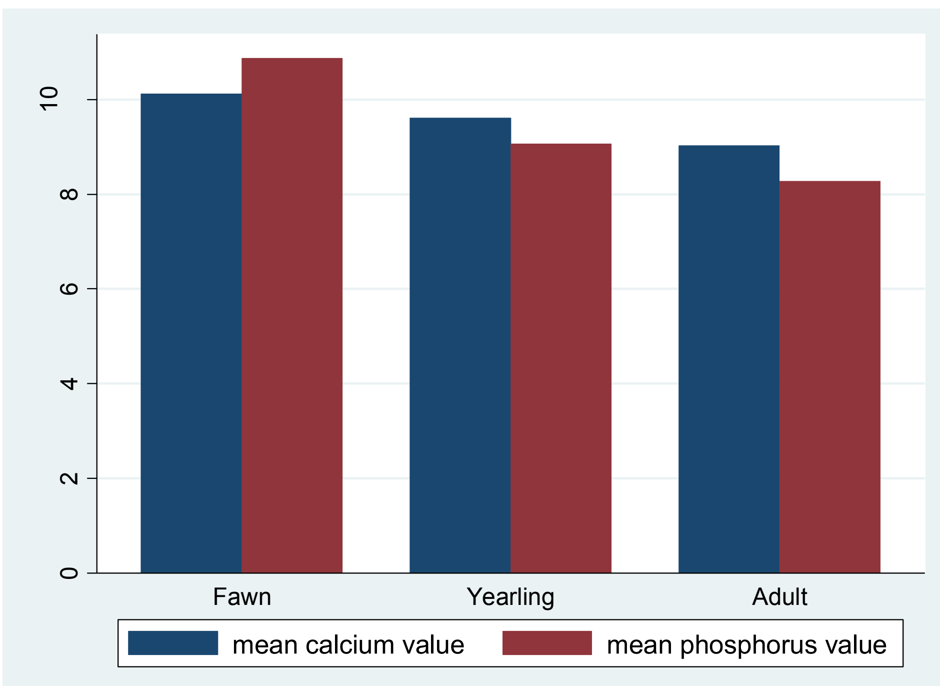

FIGURE 3: Mean values for calcium and phosphorus in captive WTD among different age groups. All WTD were physically restrained with the following age distribution: Fawns (n=45), yearlings (n=94), and adults (n=104).

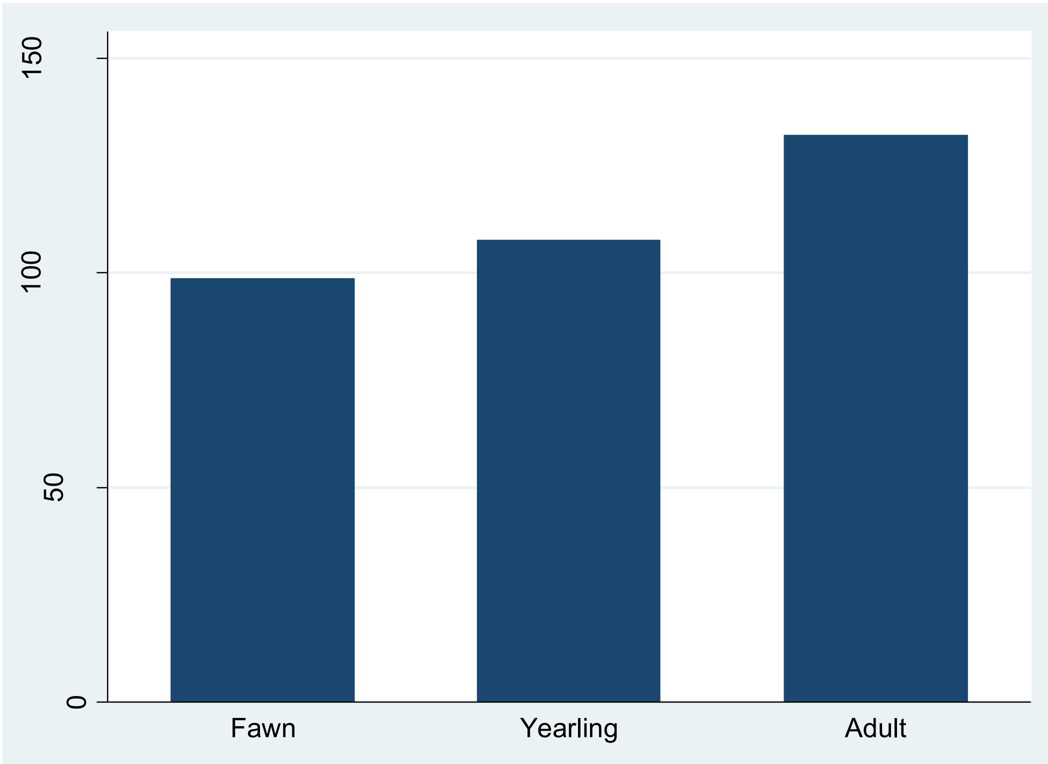

FIGURE 4: Mean values for glucose in captive WTD among different age groups. All WTD were physically restrained with the following age distribution: Fawns (n=45), yearlings (n=94), and adults (n=104).

5. SUMMARY

Previously published scientific literature and unpublished reports examining the blood chemistry of White-tailed Deer in Texas were primarily conducted to analyze the general health and overall physiologic parameters of free-ranging WTD. In Texas, there has been a steady increase in the number of captive WTD and breeding facilities over the last decade. In 2010, Texas Parks and Wildlife had record of over 100,000 captive WTD and 1500 facilities. Many of these captive WTD owners consider their animals to be very valuable with animals in auctions selling for $2,000-$460,000. In the present study, reference ranges for captive WTD were established for the two most common handling techniques, physical restraint and chemical immobilization. These reference ranges will be used for both captive and free-ranging WTD to improve diagnostic screening and disease monitoring.

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APPENDIX

Blood Chemistry Parameters

The following information regarding test reagents and imprecision was obtained from the Roche manual (Roche Diagnostics , Indianapolis, Indiana, USA).

Total Protein- Total protein measurements are used in diagnosis and treatment of a variety of diseases involving the liver, kidney, or bone marrow, as well as other metabolic or nutritional disorders.

Albumin- Albumin is a carbohydrate-free protein that constitutes 55-65% of the total plasma protein.

Calcium- Calcium ions affect the contractility of the heart and the skeletal musculature and are essential for the function of the nervous system. In addition, calcium ions play an important role in blood clotting and bone mineralization.

Phosphours- In humans, 88% of phosphorus contained in the body is localized in bone, in the form of calcium phosphate. Also, the ratio of phosphorus to calcium in the blood is approximately 6:10.

Glucose- Glucose is the most important monosaccharide in the blood and is an indispensible energy supplier which supports cellular function.

Blood Urea Nitrogen- Urea is the final degradation product of protein and amino acid metabolism, the most important catabolic pathway for eliminating excess nitrogen in the body and the most widely used test for evaluation of kidney function.

Creatinine- Creatinine is produced endogenously from creatine and creatine phosphate as a result of muscle metabolic processes.

Total Bilirubin- Bilirubin is an organic compound formed by the reticuloendothelial system during the normal and abnormal destruction of red blood cells. Measurments are used for diagnosis of liver disease.

Creatine Kinase- Creatine kinase determination is used in the diagnosis and monitoring of myocardial infarction. Following injury to the myocardium, CK is released from damaged myocardial cells.

Aspartate aminotransferase- Aspartate aminotransferase is commonly found in heart muscle, and has the most activity of the enzyme, however, it is also seen in the brain, liver, gastric mucosa, adipose tissue, skeletal muscle, and kidneys. Elevated levels of the transaminases can signal myocardial infarction, hepatic disease, muscular dystrophy, and organ damage. Gamma-glutamyltransferase (GGT) is one of the most sensitive indicators known for monitoring and diagnosing hepatobiliary disease. It is often the only parameter with an increase value when testing for such diseases.

Magnesium- Magnesium is a major intracellular cation. All adenosine triphosphate dependent reactions require magnesium. Approximately 69% of ions are stored in bones. The magnesium serum level is kept constant within very narrow limits. Regulation takes place mainly in the kidneys.

		Table A-1: Total serum protein											
		Fawns				Yearlings				Adults			
		Buck		Doe		Buck		Doe		Buck		Doe	
Physical Restraint (PR)	captive	n=	35	n=	10	n=	51	n=	43	n=	82	n=	23
		mean=	7.2	mean=	6.79	mean=	7.175	mean=	6.814	mean=	8.205	mean=	7.522
		SD=	0.667	SD=	0.534	SD=	0.635	SD=	0.524	SD=	0.758	SD=	0.609
		min=	5.8	min=	6.1	min=	6.1	min=	5.8	min=	6.7	min=	6.6
		max=	8.5	max=	7.7	max=	8.5	max=	8.1	max=	10.5	max=	8.8
	native	n=		n=		n=		n=		n=		n=	
		mean=		mean=		mean=		mean=		mean=		mean=	
		SD=		SD=		SD=		SD=		SD=		SD=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
anesthetized using PR	captive	n=	10	n=	10	n=		n=	45	n=		n=	80
		mean=	6.59	mean=	6.36	mean=		mean=	6.718	mean=		mean=	6.728
		SD=	0.574	SD=	0.564	SD=		SD=	0.409	SD=		SD=	0.383
		min=	6	min=	5.8	min=		min=	5.7	min=		min=	5.8
		max=	8.1	max=	7.7	max=		max=	7.7	max=		max=	7.8
	native	n=		n=		n=		n=		n=		n=	
		mean=		mean=		mean=		mean=		mean=		mean=	
		SD=		SD=		SD=		SD=		SD=		SD=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
anesthetized using dart gun	captive	n=		n=		n=		n=	2	n=	5	n=	14
		mean=		mean=		mean=		mean=	7.25	mean=	6.66	mean=	7.029
		SD=		SD=		SD=		SD=	0.071	SD=	0.518	SD=	0.307
		min=		min=		min=		min=	7.2	min=	6.1	min=	6.3
		max=		max=		max=		max=	7.3	max=	7.3	max=	7.5
	native	n=		n=		n=		n=		n=		n=	
		mean=		mean=		mean=		mean=		mean=		mean=	
		SD=		SD=		SD=		SD=		SD=		SD=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
drop netted	captive	n=		n=		n=		n=		n=		n=	
		mean=		mean=		mean=		mean=		mean=		mean=	
		SD=		SD=		SD=		SD=		SD=		SD=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=	29	n=	17	n=	4	n=	3	n=	11	n=	26
		mean=	7.569	mean=	7.258	mean=	7.225	mean=	7.1	mean=	7.381	mean=	7.746
		SD=	0.863	SD=	0.615	SD=	0.096	SD=	0.2	SD=	0.719	SD=	0.632
		min=	6.3	min=	6.2	min=	7.1	min=	6.9	min=	6.2	min=	6.3
		max=	9.7	max=	8.1	max=	7.3	max=	7.3	max=	8.4	max=	8.9
net gunned	captive	n=		n=		n=		n=		n=		n=	
		mean=		mean=		mean=		mean=		mean=		mean=	
		SD=		SD=		SD=		SD=		SD=		SD=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=	5	n=	3	n=	3	n=	3	n=	3	n=	35
		mean=	6.7	mean=	6	mean=	6.933	mean=	6.733	mean=	7.867	mean=	7.337
		SD=	0.583	SD=	0.173	SD=	0.839	SD=	0.666	SD=	0.289	SD=	0.505
		min=	6	min=	5.9	min=	6.4	min=	6.3	min=	7.7	min=	6.4
		max=	7.6	max=	6.2	max=	7.9	max=	7.5	max=	8.2	max=	8.6
hunter harvested	captive	n=		n=		n=		n=		n=		n=	
		mean=		mean=		mean=		mean=		mean=		mean=	
		SD=		SD=		SD=		SD=		SD=		SD=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=		n=		n=		n=		n=		n=	10
		mean=		mean=		mean=		mean=		mean=		mean=	6.5
		SD=		SD=		SD=		SD=		SD=		SD=	0.918
		min=		min=		min=		min=		min=		min=	5.5
		max=		max=		max=		max=		max=		max=	8.2

		Table A-2: Albumin levels for WTD											
		SPRING											
		Fawns				Yearlings				Adults			
		Bucks		Does		Bucks		Does		Bucks		Does	
Physical Restraint (PR)	captive	n=	24	n=	1	n=	28	n=	14	n=		n=	6
		μ=	2.84	μ=	3	μ=	3.44	μ=	3.31	μ=		μ=	3.63
		σ=	0.21	σ=	.	σ=	0.14	σ=	0.27	σ=		σ=	0.08
		min=	2.4	min=	3	min=	3.1	min=	2.6	min=		min=	3.5
		max=	3.2	max=	3	max=	3.7	max=	3.6	max=		max=	3.7
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
anesthetized using PR	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
anesthetized using dart gun	captive	n=		n=		n=		n=		n=		n=	3
		μ=		μ=		μ=		μ=		μ=		μ=	3.17
		σ=		σ=		σ=		σ=		σ=		σ=	0.12
		min=		min=		min=		min=		min=		min=	3.1
		max=		max=		max=		max=		max=		max=	3.3
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
drop netted	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=	17	n=	5	n=	1	n=	3	n=	1	n=	8
		μ=	3.45	μ=	3.34	μ=	3.8	μ=	3.27	μ=	3.7	μ=	3.48
		σ=	0.23	σ=	0.15	σ=		σ=	0.25	σ=	.	σ=	0.26
		min=	3	min=	3.2	min=	3.8	min=	3	min=	3.7	min=	3
		max=	3.9	max=	3.5	max=	3.8	max=	3.5	max=	3.7	max=	3.8
net gunned	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
hunter harvested	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	

Table A-2 (Continued): Albumin levels for WTD

		SUMMER											
		Fawns				Yearlings				Adults			
		Bucks		Does		Bucks		Does		Bucks		Does	
Physical Restraint (PR)	captive	n=		n=		n=		n=	23	n=		n=	
		μ=		μ=		μ=		μ=	3.17	μ=		μ=	
		σ=		σ=		σ=		σ=	0.27	σ=		σ=	
		min=		min=		min=		min=	2.7	min=		min=	
		max=		max=		max=		max=	3.8	max=		max=	
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
anesthetized using PR	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
anesthetized using dart gun	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
drop netted	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
net gunned	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
hunter harvested	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	

Table A-2 (Continued): Albumin levels for WTD

Method	Origin	Stat	FALL Fawns Bucks	FALL Fawns Does	FALL Yearlings Bucks	FALL Yearlings Does	FALL Adults Bucks	FALL Adults Does
Physical Restraint (PR)	captive	n=	11	9	23	6	82	17
		μ=	3.47	3.46	3.45	3.53	3.52	3.44
		σ=	0.22	0.12	0.3	0.1	0.37	0.24
		min=	3.2	3.3	2.8	3.4	1.9	3.1
		max=	3.9	3.6	4.1	3.7	4.2	3.9
	native	n=						
		μ=						
		σ=						
		min=						
		max=						
anesthetized using PR	captive	n=				45		68
		μ=				3.14		3.14
		σ=				0.25		0.21
		min=				2.5		2.6
		max=				3.6		3.5
	native	n=						
		μ=						
		σ=						
		min=						
		max=						
anesthetized using dart gun	captive	n=				2	5	11
		μ=				2.95	3.2	3.16
		σ=				0.07	0.1	0.19
		min=				2.9	3.1	2.9
		max=				3	3.3	3.4
	native	n=						
		μ=						
		σ=						
		min=						
		max=						
drop netted	captive	n=						
		μ=						
		σ=						
		min=						
		max=						
	native	n=	2	3	1		3	7
		μ=	3.35	3.17	3.4		3.3	3.56
		σ=	0.21	0.55			0.17	0.17
		min=	3.2	2.6	3.4		3.1	3.3
		max=	3.5	3.7	3.4		3.4	3.8
net gunned	captive	n=						
		μ=						
		σ=						
		min=						
		max=						
	native	n=				3		30
		μ=				3.33		3.32
		σ=				0.23		0.16
		min=				3.2		2.9
		max=				3.6		3.6
hunter harvested	captive	n=						
		μ=						
		σ=						
		min=						
		max=						
	native	n=						5
		μ=						3.16
		σ=						0.31
		min=						2.8
		max=						3.6

Table A-2 (Continued): Albumin levels for WTD

		WINTER											
		Fawns				Yearlings				Adults			
		Bucks		Does		Bucks		Does		Bucks		Does	
Physical Restraint (PR)	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
anesthetized using PR	captive	n=	10	n=	10	n=		n=		n=		n=	12
		μ=	3.31	μ=	3.3	μ=		μ=		μ=		μ=	3.3
		σ=	0.19	σ=	0.16	σ=		σ=		σ=		σ=	0.17
		min=	2.9	min=	3	min=		min=		min=		min=	3
		max=	3.5	max=	3.5	max=		max=		max=		max=	3.6
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
anesthetized using dart gun	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
drop netted	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=		n=	9	n=	2	n=		n=	7	n=	11
		μ=		μ=	3.42	μ=	3.4	μ=		μ=	3.56	μ=	3.51
		σ=		σ=	0.26	σ=	0.28	σ=		σ=	0.16	σ=	0.25
		min=		min=	2.8	min=	3.2	min=		min=	3.3	min=	2.9
		max=		max=	3.6	max=	3.6	max=		max=	3.7	max=	3.8
net gunned	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=	5	n=	3	n=	3	n=		n=	3	n=	5
		μ=	3.58	μ=	3.23	μ=	3.57	μ=		μ=	3.5	μ=	3.78
		σ=	0.13	σ=	0.12	σ=	0.47	σ=		σ=	0.35	σ=	0.23
		min=	3.4	min=	3.1	min=	3.2	min=		min=	3.1	min=	3.4
		max=	3.7	max=	3.3	max=	4.1	max=		max=	3.7	max=	4
hunter harvested	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=		n=		n=		n=		n=		n=	5
		μ=		μ=		μ=		μ=		μ=		μ=	3.24
		σ=		σ=		σ=		σ=		σ=		σ=	0.15
		min=		min=		min=		min=		min=		min=	3
		max=		max=		max=		max=		max=		max=	3.4

Table A-3: Final calcium results for WTD

Method	Group	Statistic	Fawns	Yearlings	Adults
Physical Restraint (PR)	captive	n=	45	94	105
		μ=	10.12	9.61	9.022
		σ=	0.558	0.588	0.699
		min=	9.2	7.8	6.4
		max=	12.1	10.9	10.5
	native	n=			
		μ=			
		σ=			
		min=			
		max=			
anesthetized using PR	captive	n=	20	45	80
		μ=	10.41	8.98	8.66
		σ=	0.567	0.49	0.483
		min=	9.6	7.9	7.3
		max=	12.1	9.8	9.4
	native	n=			
		μ=			
		σ=			
		min=			
		max=			
anesthetized using dart gun	captive	n=		2	19
		μ=		8.85	8.516
		σ=		0.212	0.474
		min=		8.7	7.8
		max=		9	9.4
	native	n=			
		μ=			
		σ=			
		min=			
		max=			
drop netted	captive	n=			
		μ=			
		σ=			
		min=			
		max=			
	native	n=	46	7	37
		μ=	10.67	9.557	9.857
		σ=	0.563	0.616	0.733
		min=	9.6	8.9	8.6
		max=	12.3	10.3	12
net gunned	captive	n=			
		μ=			
		σ=			
		min=			
		max=			
	native	n=	8	6	38
		μ=	10.53	9.917	10.2
		σ=	0.531	1.225	0.695
		min=	9.6	8.6	8.9
		max=	11.4	11.7	11.3
hunter harvested	captive	n=			
		μ=			
		σ=			
		min=			
		max=			
	native	n=			10
		μ=			10.78
		σ=			1.506
		min=			9
		max=			13.5

Table A-4: Final results for phosphorus in WTD

			Fawns		Yearlings		Adults	
			Bucks	Does	Bucks	Does	Bucks	Does
Physical Restraint (PR)	captive	n=	35	10	51	43	82	23
		μ=	10.79	11.17	8.885	9.277	8.413	7.763
		σ=	1.991	1.828	1.609	2.066	2.36	2.212
		min=	7.25	7.8	5.53	5.6	3.14	4.75
		max=	18.53	13.82	13.34	14.81	13.71	13.21
	native	n=						
		μ=						
		σ=						
		min=						
		max=						
anesthetized using PR	captive	n=	10	10		45		80
		μ=	8.262	7.568		5.854		5.113
		σ=	2.116	1.273		1.538		1.359
		min=	5.15	5.17		3.29		1.94
		max=	12.48	9.27		10.89		7.44
	native	n=						
		μ=						
		σ=						
		min=						
		max=						
anesthetized using dart gun	captive	n=				2	5	14
		μ=				6.505	7.88	6.254
		σ=				2.1	1.808	1.623
		min=				5.02	5.31	3.86
		max=				7.99	9.49	8.41
	native	n=						
		μ=						
		σ=						
		min=						
		max=						
drop netted	captive	n=						
		μ=						
		σ=						
		min=						
		max=						
	native	n=	29	17	4	3	11	26
		μ=	10.22	10.83	7.803	9.087	8.495	8.571
		σ=	1.394	1.356	1.807	1.106	1.054	1.432
		min=	7.89	8.41	5.41	7.81	6.7	5.99
		max=	12.8	13.6	9.79	9.74	9.87	12.58
net gunned	captive	n=						
		μ=						
		σ=						
		min=						
		max=						
	native	n=	5	3	3	3	3	35
		μ=	9.35	12.73	10.9	8.677	8.057	7.947
		σ=	0.84	0.62	1.277	0.537	0.643	1.767
		min=	8.56	12.03	9.48	8.07	7.33	3.49
		max=	10.5	13.21	11.96	9.09	8.55	10.96
hunter harvested	captive	n=						
		μ=						
		σ=						
		min=						
		max=						
	native	n=						10
		μ=						14.75
		σ=						5.921
		min=						7.33
		max=						26.35

		Table A-5: Final blood chemistry results for glucose in WTD											
		SPRING						SUMMER					
		Fawns		Yearlings		Adults		Fawns		Yearlings		Adults	
	captive	n=	25	n=	42	n=	6	n=		n=	23	n=	
		μ=	74.52	μ=	116.476	μ=	81.333	μ=		μ=	79.913	μ=	
		σ=	14.269	σ=	24.731	σ=	5.854	σ=		σ=	21.443	σ=	
		min=	43	min=	82	min=	75	min=		min=	26	min=	
		max=	106	max=	182	max=	92	max=		max=	141	max=	
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
Physical Restraint (PR)		max=		max=		max=		max=		max=		max=	
	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
anesthetized using PR		max=		max=		max=		max=		max=		max=	
	captive	n=		n=		n=	3	n=		n=		n=	
		μ=		μ=		μ=	163	μ=		μ=		μ=	
		σ=		σ=		σ=	43.555	σ=		σ=		σ=	
		min=		min=		min=	116	min=		min=		min=	
		max=		max=		max=	202	max=		max=		max=	
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
anesthetized using dart gun		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=	22	n=	4	n=	9	n=		n=		n=	
		μ=	91.364	μ=	102.5	μ=	89.222	μ=		μ=		μ=	
		σ=	32.951	σ=	21.61	σ=	38.239	σ=		σ=		σ=	
		min=	54	min=	72	min=	53	min=		min=		min=	
drop netted		max=	190	max=	123	max=	151	max=		max=		max=	
	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
net gunned		max=		max=		max=		max=		max=		max=	
	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
hunter harvested		max=		max=		max=		max=		max=		max=	

		Table A-5(Continued): Final blood chemistry results for glucose in WTD											
		FALL						WINTER					
		Fawns		Yearlings		Adults		Fawns		Yearlings		Adults	
		n=	20	n=	29	n=	99	n=		n=		n=	
		μ=	129	μ=	116.897	μ=	135.192	μ=		μ=		μ=	
	captive	σ=	58.801	σ=	53.26	σ=	53.109	σ=		σ=		σ=	
		min=	33	min=	36	min=	42	min=		min=		min=	
		max=	236	max=	290	max=	282	max=		max=		max=	
		n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
	native	σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
Physical Restraint (PR)		max=		max=		max=		max=		max=		max=	
		n=		n=	45	n=	68	n=	20	n=		n=	12
		μ=		μ=	219.267	μ=	255.603	μ=	126	μ=		μ=	232.333
	captive	σ=		σ=	72.054	σ=	70.966	σ=	55.832	σ=		σ=	61.181
		min=		min=	56	min=	136	min=	67	min=		min=	137
		max=		max=	370	max=	423	max=	260	max=		max=	343
		n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
	native	σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
anesthetized using PR		max=		max=		max=		max=		max=		max=	
		n=		n=	2	n=	16	n=		n=		n=	
		μ=		μ=	216.5	μ=	229.25	μ=		μ=		μ=	
	captive	σ=		σ=	16.263	σ=	56.867	σ=		σ=		σ=	
		min=		min=	205	min=	149	min=		min=		min=	
		max=		max=	228	max=	354	max=		max=		max=	
		n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
	native	σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
anesthetized using dart gun		max=		max=		max=		max=		max=		max=	
		n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
	captive	σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
		n=	5	n=	1	n=	10	n=	19	n=	2	n=	18
		μ=	96.4	μ=	71	μ=	91.3	μ=	109.263	μ=	101.5	μ=	95.278
	native	σ=	25.274	σ=		σ=	40.888	σ=	44.564	σ=	38.891	σ=	44.44
		min=	69	min=	71	min=	51	min=	56	min=	74	min=	33
drop netted		max=	137	max=	71	max=	172	max=	191	max=	129	max=	183
		n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
	captive	σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
		n=		n=	3	n=	30	n=	8	n=	3	n=	8
		μ=		μ=	232.333	μ=	197.233	μ=	263.75	μ=	203	μ=	238.875
	native	σ=		σ=	81.132	σ=	49.129	σ=	40.528	σ=	68.418	σ=	33.228
		min=		min=	154	min=	77	min=	202	min=	128	min=	206
net gunned		max=		max=	316	max=	272	max=	340	max=	262	max=	281
		n=		n=		n=	5	n=		n=		n=	
		μ=		μ=		μ=	251.8	μ=		μ=		μ=	
	captive	σ=		σ=		σ=	292.974	σ=		σ=		σ=	
		min=		min=		min=	65	min=		min=		min=	
		max=		max=		max=	771	max=		max=		max=	
		n=		n=		n=		n=		n=		n=	5
		μ=		μ=		μ=		μ=		μ=		μ=	235
	native	σ=		σ=		σ=		σ=		σ=		σ=	260.547
		min=		min=		min=		min=		min=		min=	59
hunter harvested		max=		max=		max=		max=		max=		max=	692

Table 6: Final blood chemistry results for BUN in WTD

Method	Group	SPRING		SUMMER		FALL		WINTER	
Physical Restraint (PR)	captive	n=	73	n=	23	n=	148	n=	
		μ=	33.255	μ=	23.343	μ=	28.691	μ=	
		σ=	7.556	σ=	2.724	σ=	7.038	σ=	
		min=	17.4	min=	17.9	min=	11.9	min=	
		max=	47.3	max=	26.7	max=	56.6	max=	
	native	n=		n=		n=		n=	
		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=	
		max=		max=		max=		max=	
anesthetized using PR	captive	n=		n=		n=	113	n=	32
		μ=		μ=		μ=	32.763	μ=	29.675
		σ=		σ=		σ=	8.554	σ=	4.946
		min=		min=		min=	13	min=	19.4
		max=		max=		max=	69.2	max=	41.1
	native	n=		n=		n=		n=	
		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=	
		max=		max=		max=		max=	
anesthetized using dart gun	captive	n=	3	n=		n=	18	n=	
		μ=	28.233	μ=		μ=	33.561	μ=	
		σ=	3.71	σ=		σ=	6.476	σ=	
		min=	24.2	min=		min=	23.9	min=	
		max=	31.5	max=		max=	46.2	max=	
	native	n=		n=		n=		n=	
		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=	
		max=		max=		max=		max=	
drop netted	captive	n=		n=		n=		n=	
		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=	
		max=		max=		max=		max=	
	native	n=	35	n=		n=	16	n=	39
		μ=	20.649	μ=		μ=	15.806	μ=	16.154
		σ=	6.559	σ=		σ=	6.828	σ=	5.823
		min=	8.5	min=		min=	5.7	min=	6.5
		max=	35.4	max=		max=	26.8	max=	28.5
net gunned	captive	n=		n=		n=		n=	
		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=	
		max=		max=		max=		max=	
	native	n=		n=		n=	33	n=	19
		μ=		μ=		μ=	17.327	μ=	23.984
		σ=		σ=		σ=	6.182	σ=	5.068
		min=		min=		min=	4	min=	16.9
		max=		max=		max=	27.8	max=	34.5
hunter harvested	captive	n=		n=		n=		n=	
		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=	
		max=		max=		max=		max=	
	native	n=		n=		n=	6	n=	5
		μ=		μ=		μ=	16.4	μ=	10.72
		σ=		σ=		σ=	6.288	σ=	2.868
		min=		min=		min=	8.4	min=	6.5
		max=		max=		max=	22.9	max=	13

Table A-7: Blood chemistry results for creatinine												
	Fawns				Yearlings				Adults			
	Bucks		Does		Bucks		Does		Bucks		Does	
captive	n=	45	n=	20	n=	51	n=	90	n=	87	n=	117
	μ=	1.239	μ=	0.999	μ=	1.111	μ=	1.165	μ=	1.654	μ=	1.349
	σ=	0.246	σ=	0.196	σ=	0.213	σ=	0.264	σ=	0.389	σ=	0.267
	min=	0.6	min=	0.66	min=	0.7	min=	0.7	min=	0.93	min=	0.84
	max=	1.84	max=	1.31	max=	1.68	max=	1.84	max=	2.61	max=	2.37
native	n=	34	n=	20	n=	7	n=	6	n=	14	n=	71
	μ=	1.714	μ=	1.525	μ=	1.956	μ=	1.572	μ=	1.958	μ=	1.558
	σ=	0.332	σ=	0.286	σ=	0.26	σ=	0.291	σ=	0.233	σ=	0.343
	min=	1.12	min=	1.17	min=	1.52	min=	1.31	min=	1.63	min=	1.03
	max=	2.45	max=	1.98	max=	2.36	max=	1.92	max=	2.36	max=	2.32

Table A-8: Final results for total bilirubin in WTD

	SPRING						SUMMER					
	Fawns		Yearlings		Adults		Fawns		Yearlings		Adults	
captive	n=	25	n=	42	n=	9	n=		n=	23	n=	
	μ=	0.232	μ=	0.424	μ=	0.506	μ=		μ=	0.342	μ=	
	σ=	0.073	σ=	0.188	σ=	0.244	σ=		σ=	0.225	σ=	
	min=	0.11	min=	0.21	min=	0.2	min=		min=	0.12	min=	
	max=	0.41	max=	1.24	max=	1.02	max=		max=	1	max=	
native	n=	22	n=	4	n=	9	n=		n=		n=	
	μ=	0.253	μ=	0.275	μ=	0.198	μ=		μ=		μ=	
	σ=	0.341	σ=	0.123	σ=	0.057	σ=		σ=		σ=	
	min=	0.1	min=	0.16	min=	0.15	min=		min=		min=	
	max=	1.76	max=	0.4	max=	0.34	max=		max=		max=	

	FALL						WINTER					
	Fawns		Yearlings		Adults		Fawns		Yearlings		Adults	
	n=	20	n=	76	n=	183	n=	20	n=		n=	12
	μ=	0.276	μ=	0.313	μ=	0.356	μ=	0.146	μ=		μ=	0.304
	σ=	0.148	σ=	0.182	σ=	0.225	σ=	0.049	σ=		σ=	0.141
	min=	0.12	min=	0.11	min=	0.1	min=	0.1	min=		min=	0.12
	max=	0.73	max=	1.1	max=	1.4	max=	0.24	max=		max=	0.54
	n=	5	n=	4	n=	45	n=	27	n=	5	n=	31
	μ=	0.16	μ=	0.118	μ=	0.172	μ=	0.172	μ=	0.144	μ=	0.167
	σ=	0.027	σ=	0.015	σ=	0.103	σ=	0.09	σ=	0.061	σ=	0.066
	min=	0.13	min=	0.1	min=	0.06	min=	0.09	min=	0.1	min=	0.07
	max=	0.2	max=	0.13	max=	0.57	max=	0.51	max=	0.25	max=	0.3

Table A-9: Blood chemistry results for creatine kinase in WTD

SPRING				SUMMER				FALL				WINTER			
Bucks		Does		Bucks		Does		Bucks		Does		Bucks		Does	
n=	52	n=	24	n=		n=	23	n=	121	n=	158	n=	10	n=	22
μ=	502.8	μ=	482.1	μ=		μ=	822.1	μ=	1184	μ=	616.5	μ=	926.3	μ=	650.2
σ=	350.2	σ=	608.2	σ=		σ=	581.2	σ=	2090	σ=	522.3	σ=	1214	σ=	707.5
min=	135	min=	10	min=		min=	311	min=	166	min=	50	min=	50	min=	119
max=	1888	max=	2462	max=		max=	2469	max=	21410	max=	3911	max=	3396	max=	2620

Table A-10: Final results for AST SGOT in WTD

Physical Restraint (PR)	captive	n=	244
		μ=	140.316
		σ=	55.826
		min=	11
		max=	602
	native	n=	
		μ=	
		σ=	
		min=	
		max=	
anesthetized using PR	captive	n=	145
		μ=	181.014
		σ=	114.02
		min=	76
		max=	626
	native	n=	
		μ=	
		σ=	
		min=	
		max=	
anesthetized using dart gun	captive	n=	21
		μ=	134.095
		σ=	34.903
		min=	92
		max=	229
	native	n=	
		μ=	
		σ=	
		min=	
		max=	
drop netted	captive	n=	
		μ=	
		σ=	
		min=	
		max=	
	native	n=	90
		μ=	124.389
		σ=	35.884
		min=	73
		max=	292
net gunned	captive	n=	
		μ=	
		σ=	
		min=	
		max=	
	native	n=	52
		μ=	114.154
		σ=	46.926
		min=	80
		max=	267
hunter harvested	captive	n=	
		μ=	
		σ=	
		min=	
		max=	
	native	n=	10
		μ=	293
		σ=	365.352
		min=	83
		max=	1308

Table A-11: Final blood chemistry values for Globulins in WTD

		Fawns				Yearlings				Adults			
		Bucks		Does		Bucks		Does		Bucks		Does	
	captive	n=	35	n=	10	n=	51	n=	43	n=	82	n=	23
		μ=	4.163	μ=	3.38	μ=	3.729	μ=	3.549	μ=	4.681	μ=	3.987
		σ=	0.909	σ=	0.509	σ=	0.608	σ=	0.603	σ=	0.875	σ=	0.654
		min=	2.6	min=	2.7	min=	2.6	min=	2.5	min=	3.3	min=	2.8
		max=	5.9	max=	4.3	max=	5.4	max=	5.3	max=	8.6	max=	5.5
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
Physical Restraint (PR)		max=		max=		max=		max=		max=		max=	
	captive	n=	10	n=	10	n=		n=	45	n=		n=	80
		μ=	3.28	μ=	3.06	μ=		μ=	3.58	μ=		μ=	3.561
		σ=	0.699	σ=	0.667	σ=		σ=	0.503	σ=		σ=	0.419
		min=	2.9	min=	2.5	min=		min=	2.6	min=		min=	2.8
		max=	5.2	max=	4.7	max=		max=	5.1	max=		max=	4.6
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
anesthetized using PR		max=		max=		max=		max=		max=		max=	
	captive	n=		n=		n=		n=	2	n=	5	n=	14
		μ=		μ=		μ=		μ=	4.3	μ=	3.46	μ=	3.864
		σ=		σ=		σ=		σ=	0	σ=	0.546	σ=	0.371
		min=		min=		min=		min=	4.3	min=	2.9	min=	3.2
		max=		max=		max=		max=	4.3	max=	4.2	max=	4.5
	native	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
anesthetized using dart gun		max=		max=		max=		max=		max=		max=	
	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=	29	n=	17	n=	4	n=	3	n=	11	n=	26
		μ=	4.138	μ=	3.906	μ=	3.725	μ=	3.833	μ=	3.882	μ=	4.235
		σ=	0.812	σ=	0.502	σ=	0.287	σ=	0.058	σ=	0.618	σ=	0.629
		min=	2.9	min=	3	min=	3.5	min=	3.8	min=	3	min=	2.8
drop netted		max=	6.7	max=	4.9	max=	4.1	max=	3.9	max=	4.7	max=	5.4
	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=		n=	3	n=	3	n=	3	n=	3	n=	35
		μ=		μ=	2.767	μ=	3.367	μ=	3.4	μ=	4.367	μ=	3.954
		σ=		σ=	0.153	σ=	0.404	σ=	0.436	σ=	0.321	σ=	0.529
		min=		min=	2.6	min=	3	min=	3.1	min=	4	min=	3.1
net gunned		max=		max=	2.9	max=	3.8	max=	3.9	max=	4.6	max=	5
	captive	n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=	
	native	n=		n=		n=		n=		n=		n=	10
		μ=		μ=		μ=		μ=		μ=		μ=	3.3
		σ=		σ=		σ=		σ=		σ=		σ=	0.858
		min=		min=		min=		min=		min=		min=	2.2
hunter harvested		max=		max=		max=		max=		max=		max=	4.6

Table A-12: Final results for A/G Ratio in WTD

SPRING

Fawns				Yearlings				Adults			
Bucks		Does		Bucks		Does		Bucks		Does	
n=	41	n=	6	n=	29	n=	17	n=	1	n=	17
μ=	0.713	μ=	0.815	μ=	1.039	μ=	1.001	μ=	0.8	μ=	0.829
σ=	0.155	σ=	0.124	σ=	0.129	σ=	0.213	σ=		σ=	0.114
min=	0.42	min=	0.65	min=	0.85	min=	0.5	min=	0.8	min=	0.58
max=	1	max=	0.95	max=	1.35	max=	1.32	max=	0.8	max=	0.97

SUMMER

Fawns				Yearlings				Adults			
Bucks		Does		Bucks		Does		Bucks		Does	
n=		n=		n=		n=	23	n=		n=	
μ=		μ=		μ=		μ=	0.904	μ=		μ=	
σ=		σ=		σ=		σ=	0.18	σ=		σ=	
min=		min=		min=		min=	0.53	min=		min=	
max=		max=		max=		max=	1.18	max=		max=	

FALL

Fawns				Yearlings				Adults			
Bucks		Does		Bucks		Does		Bucks		Does	
n=	13	n=	12	n=	24	n=	56	n=	90	n=	138
μ=	1.092	μ=	1.003	μ=	0.841	μ=	0.897	μ=	0.797	μ=	0.863
σ=	0.135	σ=	0.184	σ=	0.127	σ=	0.149	σ=	0.172	σ=	0.129
min=	0.8	min=	0.65	min=	0.52	min=	0.51	min=	0.22	min=	0.57
max=	1.3	max=	1.26	max=	1.08	max=	1.19	max=	1.1	max=	1.18

WINTER

Fawns				Yearlings				Adults			
Bucks		Does		Bucks		Does		Bucks		Does	
n=	25	n=	22	n=	5	n=		n=	10	n=	33
μ=	1.001	μ=	1.041	μ=	0.998	μ=		μ=	0.894	μ=	1.032
σ=	0.23	σ=	0.195	σ=	0.136	σ=		σ=	0.166	σ=	0.19
min=	0.45	min=	0.64	min=	0.78	min=		min=	0.67	min=	0.68
max=	1.4	max=	1.36	max=	1.13	max=		max=	1.19	max=	1.5

Table A-13: Final results for GGT in WTD

SPRING						SUMMER					
Fawns		Yearlings		Adults		Fawns		Yearlings		Adults	
n=	47	n=	46	n=	18	n=		n=	23	n=	
μ=	52.38	μ=	69.35	μ=	50.14	μ=		μ=	58.44	μ=	
σ=	11.88	σ=	18.72	σ=	8.351	σ=		σ=	18.18	σ=	
min=	33	min=	27	min=	39.4	min=		min=	32.6	min=	
max=	88	max=	114	max=	73	max=		max=	106.3	max=	

FALL						WINTER					
Fawns		Yearlings		Adults		Fawns		Yearlings		Adults	
n=	25	n=	80	n=	228	n=	47	n=	5	n=	43
μ=	99.22	μ=	60.73	μ=	63.33	μ=	77.26	μ=	98.6	μ=	61.95
σ=	207.9	σ=	20.14	σ=	24.11	σ=	72.65	σ=	77.29	σ=	30.07
min=	13.4	min=	15.3	min=	12.2	min=	24	min=	49	min=	27
max=	1094	max=	148	max=	232	max=	516	max=	234	max=	190

Table A-14: Final results for Magnesium in WTD

		SPRING				SUMMER				FALL				WINTER			
		Bucks		Does		Bucks		Does		Bucks		Does		Bucks		Does	
Physical Restraint (PR)	captive	n=	52	n=	21	n=		n=	23	n=	116	n=	32	n=		n=	
		μ=	1.836	μ=	1.867	μ=		μ=	1.828	μ=	2.046	μ=	2.004	μ=		μ=	
		σ=	0.157	σ=	0.122	σ=		σ=	0.135	σ=	0.259	σ=	0.209	σ=		σ=	
		min=	1.47	min=	1.66	min=		min=	1.59	min=	1.47	min=	1.58	min=		min=	
		max=	2.16	max=	2.07	max=		max=	2.06	max=	3.33	max=	2.47	max=		max=	
	native	n=		n=		n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=		max=		max=	
anesthetized using PR	captive	n=		n=		n=		n=		n=		n=	113	n=	10	n=	22
		μ=		μ=		μ=		μ=		μ=		μ=	1.835	μ=	2.051	μ=	1.907
		σ=		σ=		σ=		σ=		σ=		σ=	0.17	σ=	0.26	σ=	0.221
		min=		min=		min=		min=		min=		min=	1.4	min=	1.72	min=	1.62
		max=		max=		max=		max=		max=		max=	2.45	max=	2.48	max=	2.29
	native	n=		n=		n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=		max=		max=	
anesthetized using dart gun	captive	n=		n=	3	n=		n=		n=	5	n=	13	n=		n=	
		μ=		μ=	1.83	μ=		μ=		μ=	2.008	μ=	1.704	μ=		μ=	
		σ=		σ=	0.095	σ=		σ=		σ=	0.165	σ=	0.196	σ=		σ=	
		min=		min=	1.72	min=		min=		min=	1.74	min=	1.35	min=		min=	
		max=		max=	1.92	max=		max=		max=	2.19	max=	2	max=		max=	
	native	n=		n=		n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=		max=		max=	
drop netted	captive	n=		n=		n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=		max=		max=	
	native	n=	19	n=	16	n=		n=		n=	6	n=	10	n=	19	n=	20
		μ=	2.436	μ=	2.504	μ=		μ=		μ=	2.62	μ=	2.847	μ=	2.453	μ=	2.525
		σ=	0.234	σ=	0.259	σ=		σ=		σ=	0.252	σ=	0.268	σ=	0.335	σ=	0.169
		min=	2.14	min=	2.1	min=		min=		min=	2.28	min=	2.43	min=	1.86	min=	2.2
		max=	2.96	max=	2.94	max=		max=		max=	2.9	max=	3.2	max=	3.17	max=	2.81
net gunned	captive	n=		n=		n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=		max=		max=	
	native	n=		n=		n=		n=		n=	33	n=	5	n=	11	n=	8
		μ=		μ=		μ=		μ=		μ=	2.941	μ=	3.91	μ=	2.75	μ=	2.678
		σ=		σ=		σ=		σ=		σ=	0.311	σ=	0.552	σ=	0.311	σ=	0.278
		min=		min=		min=		min=		min=	2.23	min=	3.07	min=	2.26	min=	2.21
		max=		max=		max=		max=		max=	3.49	max=	4.57	max=	3.32	max=	3
hunter harvested	captive	n=		n=		n=		n=		n=		n=		n=		n=	
		μ=		μ=		μ=		μ=		μ=		μ=		μ=		μ=	
		σ=		σ=		σ=		σ=		σ=		σ=		σ=		σ=	
		min=		min=		min=		min=		min=		min=		min=		min=	
		max=		max=		max=		max=		max=		max=		max=		max=	
	native	n=		n=		n=		n=		n=		n=	5	n=		n=	5
		μ=		μ=		μ=		μ=		μ=		μ=	3.91	μ=		μ=	3.048
		σ=		σ=		σ=		σ=		σ=		σ=	0.552	σ=		σ=	0.896
		min=		min=		min=		min=		min=		min=	3.07	min=		min=	2.08
		max=		max=		max=		max=		max=		max=	4.57	max=		max=	4.51

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