Characteristics of North American Suri Alpacas

Sponsors and Project Design:
The Suri Network
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Ameripaca Alpaca Breeding Company, Galesville, Maryland
Latah Creek Alpacas, Mica, Washington
Leraso Farm Alpacas, Long Grove, Illinois
Pucara International, McMinnville, Oregon
Super Suris, Mead, Washington
Sur-real Alpacas, Westfield, Indiana

Data summary, analysis, and report:
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Goal:
This study was designed to establish means, extreme values, and measures of variability for objectively measured body weight, height at withers, and numerous fleece, fiber, skin, and blood characteristics of 2-yr-old male and female Suri alpacas representing diverse genetics and environments. In addition, subjective assessments of several traits (e.g., color, lock consistency, and luster) were also recorded. The intention is that these data will serve as benchmarks for Suri alpacas in North America. This unique information will be made available to breeders, veterinarians, and fiber specialists as well as the scientific community in general.

Background:
The scientific literature contains a relatively small amount of information on the Suri alpaca in general and even less concerning the animals being maintained under variable North American conditions, most of which are vastly different from the animals' native Andean environment. Breeders and veterinarians were in need of this information to enhance their breeding programs, understanding of fiber production and quality, diagnoses, and prescriptions. Flocks and individual animals were selected for this study to provide adequate representation of the major Bolivian, Chilean, and Peruvian bloodlines currently present in the U.S.

Materials and Methods:
The original intent was to identify 100 2-yr-old Suri alpacas for this study. Forms were created and provided to breeders to assist with uniformity and completeness of data collection. The breeders were instructed to record the following information at the time of shearing (Spring, 2006) of the second 12-month fleece from each of their nominated animals.
*Location of farm, age, color, ARI number, sex (pregnancy status for females, intact or castrated for males) body weight after shearing, body condition score, height to withers, and weight of fleece components (blanket, neck, seconds, and total). All fleece weights and staple lengths were subsequently adjusted to 365-d of growth. Fleece samples (~5 X 5 cm each, shorn at skin level) and skin biopsies were taken from the right-hand-side of each animal close to the mid-blanket. In addition, photographs were taken of the head, left and right profile, and close-up of fiber.
*Staple samples were measured by Ian Watt using an OFDA2000 instrument.
*Follicle and fiber measurements were made in the lab of Dr. Jim E. Watts. One sub-set of skin samples was measured by Dr. Norm Evans.
*Staple samples were subjectively assessed for luster and also measured for luster (some in the raw state but most after washing) by Bossa Nova Technologies using the SAMBA System.
*Another set of staples was sent to the vet school at Washington State University where Chris Davitt measured scale length and thickness on individual fibers of known diameter using a Hitachi S570 Scanning Electron Microscope.
*Blood samples were drawn from each animal at shearing time and analyzed for serum mineral levels at Michigan State University (Diagnostic Center for Population and Animal Health) and metabolic profiles and cell blood counts with differential at Oregon State University (Veterinary Diagnostic Lab).

Statistical analysis:
Data from the multiple sources were combined into a single spreadsheet and then imported into the SAS (version 9.1) statistical software program (SAS Institute, Cary, NC). The MEANS procedure of SAS was used to calculate means, standard deviations, coefficients of variation, minimum and maximum values for each measured trait. The GLM procedure of SAS was used to calculate least squares means and identify differences in traits between males and females and colored versus white alpacas. The CORR procedure of SAS was used to calculate correlation coefficients between all measured traits.

Results:
Means, measures of variation, minimum and maximum values for all the traits measured or scored on the 2-yr-old Suri alpacas are listed in Table 1. In all, 63 animals participated in the study but, for numerous reasons, all traits were not measured on all animals. In the table, N indicates the number of samples or animals measured for a particular trait. The data are presented first for both sexes (Table 1) followed by female (N=33) and male (N=27) separately (Table 2). Most of the females were pregnant (4 were open, 6 unreported status) and

most of the males were intact (1 castrated, 6 unreported status). Traits that differed significantly between the sexes are listed in Table 3.

The data were also summarized in terms of colored versus white animals (Table 4). Traits that differed between colored and white animals are listed in Table 5. Traits were also summarized by location (Appendix Table 1). The latter information is presented in the Appendix for the sole purpose of providing means, variability, etc. for this specific data set. Representation from Central (N=22), East (N=10), and West (N=31) regions of the U.S. and data from a single production year are not considered adequate to draw meaningful conclusions concerning geographic or environmental effects on Suri alpacas.

In the cases of the complete blood counts, profiles, and mineral analyses, an extra variable was introduced. This is the variable abbreviation followed by the numerals 123, e.g. BUN is followed by BUN123. This variable simply indicates whether the parent variable was designated low (1), normal (2), or high (3) by the lab conducting the testing.

Key to abbreviations used in the tables:

AGE: age, yr
BWKG: bodyweight, kg
HTCM: height at withers, cm
BCS: body condition score, 1-10

ADJBLANK: adjusted blanket weight, kg
ADJNECKW: adjusted neck weight, kg
ADJBLNEW: adjusted blanket and neck weight, kg
ADJSECWT: adjusted seconds weight, kg
ADJTOTFL: adjusted total fleece weight, kg

AFD: average fiber diameter, microns
SDFD: standard deviation of fiber diameter, microns
CVFD: coefficient of variation of fiber diameter, %
LESS15: fibers finer than 15 microns, %
CF: comfort factor, % fibers < or = to 30 microns
ADJSLMM: adjusted staple length, mm
CRV: average curvature, deg/mm

AFDBIOP: average fiber diameter measured from biopsy, microns
SPRATIO: secondary to primary follicle ratio
FD: follicle density, follicles/mm^2
SKINTHIC: skin thickness, mm
GROWRAT: fiber growth rate, mm/d
FLSLRATI: fiber length to staple length ratio
PRIMAFD: average diameter of fibers produced in primary follicles, microns
PRIMSDFD: standard deviation of fiber diameter of fibers produced in primary follicles, microns

PRIMCVFD: coefficient of variation of fiber diameter of fibers produced in primary follicles, microns
PRIMMIN: finest primary fiber, microns
PRIMMAX: coarsest primary fiber, microns
PRIMMED: medullation of primary fibers, %
SECAFD: average diameter of fibers produced in secondary follicles, microns
SECSDFD: standard deviation of fiber diameter of fibers produced in secondary follicles, microns
SECCVFD: coefficient of variation of fiber diameter of fibers produced in secondary follicles, microns
SECMIN: finest secondary fiber, microns
SECMAX: coarsest secondary fiber, microns
SECMED: medullation of secondary fibers, %
ADJMFL: adjusted mean fiber length, mm
ADJFLSD: adjusted standard deviation of fiber length, mm
FLCV: coefficient of variation of adjusted fiber length, %
ADJFLMIN: adjusted minimum fiber length, mm
ADJFLMAX: adjusted maximum fiber length, mm

SCTH: average scale thickness, nanometers
SCL: average scale length, microns

RAWLUSSC: raw luster score, 1-3
CLLUSTSC: clean luster score, 1-3
LOCKCON: lock consistency, 1-10

DIFFINT: diffused integral (SAMBA luminance)
RRL: luster (Reich-Robbins formula)

BUN: blood urea nitrogen, mg/dl

CREATINI: creatinine, mg/dl
GLUCOSE: glucose, mg/dl
TOTPROT: total serum protein, g/dl
ALBUMIN: albumin, g/dl
TOTBILR: total bilirubin, mg/dl
CK: creatinine kinase, U/L
GGT: gamma-glutamyl transpeptidase, U/L
ASTSGOT: aspartate aminotransferase (SGOT) U/L
SOD: sodium, serum, mEq/L
POT: potassium, serum, mEq/L
CL: chloride, serum, mEq/L
CAL: calcium, serum, mg/dl
PHOS: phosphorus, serum, mg/dl
MG: magnesium, serum, mg/dl
TCO2: total carbon dioxide, mEq/L
SDH: succinate dehydrogenase, U/L

ANIONGAP: anion gap, mEq/L

TOTWBC: total white blood cells, /ul
DIFNEUT: differential neutrophils, %
DIFBANDS: differential bands, %
DIFMYEL: differential myelocytes, %
DIFLYMPH: differential lymphocytes, %
DIFMONO: differential monocytes, %
DIFEOSIN: differential eosinophils, %
DIFBASO: differential basophils, %
NEUT: absolute neutrophils, /ul
BANDS: absolute bands, /ul
LYMPHOCY: absolute lymphocytes, /ul
MONOCYTE: absolute monocytes, /ul
EOSINPHI: absolute eosinophils, /ul
BASOPHIL: absolute basophils, /ul
RBC: red blood cells, X 10e6/ul
HEMOGLO: hemoglobin, blood, g/dl
SPUNPCV: spun packed cell volume, %
MCH: mean corpuscular hemoglobin, pg
NUCRBC: nucleated red blood cells, #/100 WBC
PLATELEC: platelet count, X 1000/ul
PLASPRO: plasma protein, g/dl
FIBRINOG: fibrinogen, mg/dl
RBCMO123: red blood count morphology, 2=normal, or word description
WBCMO123: white blood count morphology, 2=normal, or word description

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SE: selenium, ng/mL
BORON: boron, ppm
CA: calcium, ppm
CR: chromium, ppm
CU: copper, ppm
FE: iron, ppm
MAG: magnesium, ppm
PS: phosphorus, ppm
K: potassium, ppm
NA: sodium, ppm
ZN: zinc, ppm

Table 1. Means, variability, minimum and maximum values for all animals and all traits measured

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
AGE	AGE	63	2.36	0.49	20.73	1.49	3.71
BWKG	BWKG	50	74.74	11.42	15.28	52.16	105.23
HTCM	HTCM	56	89.98	3.47	3.85	82.55	99.06
BCS	BCS	57	5.88	0.94	15.94	4.50	8.00
ADJBLANK	ADJBLANK	61	1.49	0.50	33.37	0.44	3.09
ADJNECKW	ADJNECKW	57	0.62	0.22	35.86	0.03	1.16
ADJBLNEW	ADJBLNEW	61	2.06	0.59	28.39	0.72	3.22
ADJSECWT	ADJSECWT	35	0.63	0.42	67.55	0.05	1.60
ADJTOTFL	ADJTOTFLKG	35	2.63	0.81	30.84	0.86	4.12
AFD	AFD	63	26.08	4.38	16.79	19.70	39.60
SDFD	SDFD	63	5.44	1.07	19.65	3.90	9.00
CVFD	CVFD	63	20.85	2.04	9.81	16.50	26.20
LESS15	LESS15	63	0.95	1.33	140.71	0.00	7.60
CF	CF	63	77.98	21.74	27.88	9.60	98.20
ADJSLMM	ADJSLMM	63	136.08	20.31	14.92	78.28	179.93
CRV	CRV	63	11.32	1.80	15.90	7.30	16.90
AFDBIOP	AFDBIOP	55	27.04	4.56	16.84	19.60	41.40
SPRATIO	SPRATIO	61	7.66	1.89	24.61	3.20	12.50
FD	FD	62	28.89	8.78	30.40	11.60	63.00
SKINTHIC	SKINTHICK	55	2.41	0.41	16.84	1.70	3.76
GROWRAT	GROWRAT	40	0.41	0.06	14.47	0.30	0.56
FLSLRATI	FLSLRATI	54	0.94	0.05	4.93	0.77	0.98
PRIMAFD	PRIMAFD	55	37.77	5.56	14.72	28.10	53.60
PRIMSDFD	PRIMSDFD	55	5.80	1.73	29.83	2.60	11.10
PRIMCVFD	PRIMCVFD	55	15.38	3.77	24.50	8.50	28.80
PRIMMIN	PRIMMIN	55	26.60	4.01	15.07	16.00	35.00
PRIMMAX	PRIMMAX	55	53.16	8.43	15.87	36.00	78.00
PRIMMED	PRIMMED	49	99.84	0.90	0.90	94.00	100.00
SECAFD	SECAFD	55	25.73	4.50	17.49	18.60	39.90
SECSDFD	SECSDFD	54	4.08	0.97	23.74	2.80	8.50
SECCVFD	SECCVFD	55	16.12	3.32	20.62	11.30	31.30
SECMIN	SECMIN	55	16.31	4.14	25.36	8.00	30.00
SECMAX	SECMAX	55	36.82	7.60	20.64	27.00	64.00
SECMED	SECMED	49	59.57	32.05	53.80	1.00	100.00
ADJMFL	ADJMFL	54	150.75	22.52	14.94	98.63	205.56
ADJFLSD	ADJFLSD	54	9.26	8.05	86.96	2.36	36.21
FLCV	FLCV	54	6.49	5.68	87.50	1.30	24.90
ADJFLMIN	ADJFLMIN	54	126.56	28.89	22.83	49.21	174.30
ADJFLMAX	ADJFLMAX	54	164.14	26.54	16.17	103.55	233.86
SCTH	SCTH	20	430.68	87.10	20.22	297.00	608.00
SCL	SCL	29	13.17	1.85	14.03	10.77	18.06
RAWLUSSC	RAWLUSSC	50	1.68	0.51	30.52	1.00	3.00
CLLUSTSC	CLLUSTSC	50	1.98	0.65	33.05	1.00	3.00
DIFFINT	DIFFINT	33	1100.5	1221.2	110.97	17.00	3448.0
RRL	RRL	33	0.20	0.25	125.53	0.02	0.87
LOCKCON	LOCKCON	50	5.52	1.23	22.33	3.00	8.00
BUN	BUN	59	19.58	4.99	25.51	8.00	33.00

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
BUN123	BUN123	59	2.02	0.23	11.24	1.00	3.00
CREATINI	CREATINI	59	1.55	0.31	19.94	1.00	2.40
CREAT123	CREAT123	59	2.20	0.41	18.43	2.00	3.00
GLUCOSE	GLUCOSE	59	124.78	31.60	25.33	9.00	207.00
GLUC123	GLUC123	59	2.14	0.43	20.31	1.00	3.00

TOTPROT	TOTPROT	59	6.61	0.41	6.24	5.20	7.60
TPROT123	TPROT123	59	2.19	0.39	17.97	2.00	3.00
ALBUMIN	ALBUMIN	59	4.94	5.45	110.29	3.30	46.00
ALBUM123	ALBUM123	59	1.98	0.13	6.57	1.00	2.00
TOTBILR	TOTBILR	51	0.10	0.00	0.00	0.10	0.10
BILRU123	BILRU123	59	2.00	0.00	0.00	2.00	2.00
CK	CK	59	167.07	247.30	148.02	32.00	1729.0
CK123	CK123	59	1.98	0.23	11.44	1.00	3.00
GGT	GGT	59	19.92	7.02	35.26	6.00	41.00
GGT123	GGT123	59	1.98	0.23	11.44	1.00	3.00
ASTSGOT	ASTSGOT	59	194.95	70.37	36.10	113.00	592.00
AST123	AST123	59	2.00	0.26	13.13	1.00	3.00
SOD	SOD	59	149.25	2.76	1.85	144.00	158.00
SOD123	SOD123	59	2.02	0.13	6.45	2.00	3.00
POT	POT	59	5.36	0.89	16.55	4.00	8.50
POT123	POT123	59	2.10	0.30	14.50	2.00	3.00
CL	CL	59	108.25	2.96	2.73	97.00	114.00
CL123	CL123	59	1.98	0.13	6.57	1.00	2.00
CAL	CAL	59	9.88	0.42	4.30	8.80	11.10
CAL123	CAL123	59	2.07	0.25	12.26	2.00	3.00
PHOS	PHOS	59	9.56	13.71	143.40	4.80	104.00
PHOS123	PHOS123	59	2.02	0.13	6.45	2.00	3.00
MG	MG	59	2.30	0.20	8.74	1.89	2.86
MG123	MG123	59	2.58	0.50	19.35	2.00	3.00
TCO2	TCO2	59	26.88	3.57	13.26	16.70	32.70
TCO2123	TCO2123	59	1.92	0.38	20.08	1.00	3.00
SDH	SDH	59	5.74	4.81	83.88	0.70	35.10
SDH123	SDH123	59	1.97	0.26	13.24	1.00	3.00
ANIONGAP	ANIONGAP	59	19.51	4.54	23.28	14.00	35.00
AG123	AG123	59	2.03	0.32	15.72	1.00	3.00
TOTWBC	TOTWBC	58	15412	5180.9	33.62	1000.0	25100
WBC123	WBC123	58	2.00	0.42	20.94	1.00	3.00
DIFNEUT	DIFNEUT	58	52.95	11.97	22.60	25.00	82.00
DIFNE123	DIFNE123	58	2.22	0.42	18.91	2.00	3.00
DIFBANDS	DIFBANDS	4	1.00	0.00	0.00	1.00	1.00
DIFB123	DIFB123	4	3.00	0.00	0.00	3.00	3.00
DIFMYEL	DIFMYEL	4	7.75	11.50	148.39	2.00	25.00
DIFLYMPH	DIFLYMPH	57	33.65	12.51	37.19	6.00	67.00
DIFLY123	DIFLY123	57	1.68	0.47	27.84	1.00	2.00
DIFMONO	DIFMONO	51	3.39	2.53	74.60	0.00	14.00
DIFMO123	DIFMO123	51	2.08	0.27	13.06	2.00	3.00
DIFEOSIN	DIFEOSIN	57	9.02	6.19	68.60	1.00	30.00

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Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
DIFEO123	DIFEO123	57	2.00	0.00	0.00	2.00	2.00
DIFBASO	DIFBASO	9	2.44	3.24	132.74	1.00	11.00
DIFBA123	DIFBA123	9	2.11	0.33	15.79	2.00	3.00
NEUT	NEUT	58	8046.0	3228.9	40.13	580.00	16750
NEUT123	NEUT123	58	1.91	0.39	20.26	1.00	3.00
BANDS	BANDS	14	224.64	109.73	48.84	102.00	459.00
BANDS123	BANDS123	13	2.69	0.48	17.84	2.00	3.00
LYMPHOCY	LYMPHOCY	58	5184.9	3005.2	57.96	38.00	14941
LYMPH123	LYMPH123	58	2.40	0.59	24.64	1.00	3.00
MONOCYTE	MONOCYTE	51	495.51	402.67	81.26	0.00	2112.0
MONO123	MONO123	51	2.08	0.27	13.06	2.00	3.00
EOSINPHI	EOSINPHI	57	1510.0	1319.5	87.38	36.00	6120.0
EOSIN123	EOSIN123	57	1.82	0.50	27.64	1.00	3.00
BASOPHIL	BASOPHIL	11	304.27	477.76	157.02	1.00	1727.0
BASO123	BASO123	10	2.10	0.32	15.06	2.00	3.00
RBC	RBC	58	15.43	2.45	15.86	9.88	20.00
RBC123	RBC123	58	2.24	0.47	20.99	1.00	3.00
HEMOGLO	HEMOGLO	58	14.60	1.72	11.80	10.20	17.90
HGB123	HGB123	58	1.93	0.26	13.24	1.00	2.00
SPUNPCV	SPUNPCV	58	31.54	4.85	15.37	17.00	40.00
PCV123	PCV123	58	1.84	0.37	19.80	1.00	2.00
MCH	MCH	58	9.55	0.82	8.60	7.80	11.50
MCH123	MCH123	58	1.57	0.50	31.84	1.00	2.00
NUCRBC	NUCRBC	19	14.58	53.65	368.01	1.00	236.00
PLATELEC	PLATELEC	28	288.61	158.58	54.95	72.00	554.00
PLATE123	PLATE123	42	1.88	0.71	37.51	1.00	3.00
PLASPRO	PLASPRO	58	6.66	0.44	6.59	5.50	7.70
PPROT123	PPROT123	58	2.02	0.23	11.34	1.00	3.00
FIBRINOG	FIBRINOG	55	241.82	111.71	46.19	100.00	500.00
FIBRI123	FIBRI123	58	1.97	0.18	9.36	1.00	2.00
RBCMO123	RBCMO123	35	2.00	0.00	0.00	2.00	2.00
WBCMO123	WBCMO123	57	2.00	0.00	0.00	2.00	2.00
SE	SE	55	169.47	37.36	22.04	83.00	263.00
SE123	SE123	55	2.49	0.69	27.72	1.00	3.00
BORON	BORON	61	1.00	0.00	0.00	1.00	1.00
BORON123	BORON123	61	2.00	0.00	0.00	2.00	2.00
CA	CA	61	94.84	3.62	3.81	88.00	106.00
CA123	CA123	61	2.02	0.13	6.35	2.00	3.00
CR	CR	61	0.10	0.00	0.00	0.10	0.10
CR123	CR123	61	2.00	0.00	0.00	2.00	2.00
CU	CU	61	0.46	0.09	19.35	0.16	0.68
CU123	CU123	61	1.98	0.13	6.45	1.00	2.00
FE	FE	61	1.28	0.24	18.98	0.81	1.80
FE123	FE123	61	2.00	0.00	0.00	2.00	2.00
MAG	MAG	61	22.27	1.85	8.32	18.20	27.10
MAG123	MAG123	61	2.03	0.18	8.83	2.00	3.00
PS	PS	61	69.92	14.74	21.08	40.00	112.00

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
PS123	PS123	61	2.05	0.22	10.64	2.00	3.00
K	K	61	192.05	26.92	14.02	161.00	325.00
K123	K123	61	2.02	0.13	6.35	2.00	3.00
NA	NA	61	3488.2	98.51	2.82	3330.0	3710.0
NA123	NA123	61	2.00	0.00	0.00	2.00	2.00
ZN	ZN	61	0.27	0.12	43.85	0.10	0.66
ZN123	ZN123	61	1.80	0.60	33.30	1.00	3.00

Table 2. All traits, females only.

---------- SEX=F ----------

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
AGE	AGE	33	2.31	0.44	18.84	1.70	3.50
BWKG	BWKG	29	78.30	12.41	15.85	53.62	105.23
HTCM	HTCM	29	90.45	3.86	4.27	83.82	99.06
BCS	BCS	29	6.10	0.87	14.25	5.00	8.00
ADJBLANK	ADJBLANK	33	1.53	0.56	36.63	0.44	3.09
ADJNECKW	ADJNECKW	30	0.60	0.20	34.27	0.28	1.13
ADJBLNEW	ADJBLNEW	33	2.06	0.59	28.55	0.72	3.22
ADJSECWT	ADJSECWT	21	0.67	0.39	57.96	0.09	1.33
ADJTOTFL	ADJTOTFLKG	21	2.72	0.88	32.50	0.86	4.00
AFD	AFD	33	26.71	5.18	19.39	19.70	39.60
SDFD	SDFD	33	5.55	1.21	21.76	4.20	9.00
CVFD	CVFD	33	20.75	2.12	10.23	16.50	26.20
LESS15	LESS15	33	0.89	1.44	161.77	0.00	7.60
CF	CF	33	74.66	26.51	35.51	9.60	98.20
ADJSLMM	ADJSLMM	33	138.67	23.01	16.59	78.28	179.93
CRV	CRV	33	11.17	1.74	15.53	7.30	13.90
AFDBIOP	AFDBIOP	31	27.35	5.00	18.29	19.60	41.40
SPRATIO	SPRATIO	31	7.49	1.99	26.55	3.20	12.50
FD	FD	32	26.21	6.59	25.13	11.60	39.60
SKINTHIC	SKINTHICK	31	2.35	0.38	16.06	1.70	3.13
GROWRAT	GROWRAT	25	0.42	0.06	14.87	0.30	0.56
FLSLRATI	FLSLRATI	31	0.94	0.04	3.97	0.84	0.98
PRIMAFD	PRIMAFD	31	38.01	6.10	16.04	28.10	53.60
PRIMSDFD	PRIMSDFD	31	6.04	1.93	31.97	2.60	11.10
PRIMCVFD	PRIMCVFD	31	15.89	4.28	26.90	8.50	28.80
PRIMMIN	PRIMMIN	31	26.16	4.61	17.60	16.00	33.00
PRIMMAX	PRIMMAX	31	54.19	9.57	17.66	36.00	78.00
PRIMMED	PRIMMED	30	99.73	1.14	1.15	94.00	100.00
SECAFD	SECAFD	31	26.09	4.92	18.86	18.60	39.90
SECSDFD	SECSDFD	30	4.20	1.16	27.65	2.80	8.50
SECCVFD	SECCVFD	31	16.32	3.85	23.61	11.30	31.30
SECMIN	SECMIN	31	16.71	4.47	26.73	10.00	30.00

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Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
SECMAX	SECMAX	31	37.65	9.07	24.09	28.00	64.00
SECMED	SECMED	30	57.80	33.50	57.95	6.00	100.00
ADJMFL	ADJMFL	31	153.85	24.04	15.62	110.40	205.56
ADJFLSD	ADJFLSD	31	9.75	8.20	84.09	3.01	35.95

FLCV	FLCV	31	6.27	4.88	77.92	1.90	22.00
ADJFLMIN	ADJFLMIN	31	129.41	28.42	21.96	65.82	174.30
ADJFLMAX	ADJFLMAX	31	166.51	29.51	17.72	114.69	233.86
SCTH	SCTH	10	435.39	95.50	21.93	297.00	608.00
SCL	SCL	18	13.48	1.91	14.19	10.77	18.06
RAWLUSSC	RAWLUSSC	27	1.52	0.51	33.53	1.00	2.00
CLLUSTSC	CLLUSTSC	27	1.96	0.71	35.97	1.00	3.00
DIFFINT	DIFFINT	19	1483.5	1270.3	85.63	27.00	3448.0
RRL	RRL	19	0.14	0.22	154.57	0.02	0.75
LOCKCON	LOCKCON	27	5.48	1.12	20.47	3.00	7.00
BUN	BUN	32	18.97	3.96	20.89	11.00	27.00
BUN123	BUN123	32	2.00	0.00	0.00	2.00	2.00
CREATINI	CREATINI	32	1.62	0.34	21.16	1.10	2.40
CREAT123	CREAT123	32	2.22	0.42	18.93	2.00	3.00
GLUCOSE	GLUCOSE	32	121.16	32.00	26.42	9.00	186.00
GLUC123	GLUC123	32	2.09	0.47	22.24	1.00	3.00
TOTPROT	TOTPROT	32	6.68	0.36	5.42	6.00	7.40
TPROT123	TPROT123	32	2.28	0.46	20.02	2.00	3.00
ALBUMIN	ALBUMIN	32	5.65	7.37	130.30	4.00	46.00
ALBUM123	ALBUM123	32	2.00	0.00	0.00	2.00	2.00
TOTBILR	TOTBILR	31	0.10	0.00	0.00	0.10	0.10
BILRU123	BILRU123	32	2.00	0.00	0.00	2.00	2.00
CK	CK	32	152.91	168.87	110.44	32.00	905.00
CK123	CK123	32	2.00	0.25	12.70	1.00	3.00
GGT	GGT	32	20.34	7.20	35.37	6.00	41.00
GGT123	GGT123	32	2.00	0.25	12.70	1.00	3.00
ASTSGOT	ASTSGOT	32	198.34	90.84	45.80	113.00	592.00
AST123	AST123	32	2.03	0.31	15.24	1.00	3.00
SOD	SOD	32	150.22	3.00	2.00	145.00	158.00
SOD123	SOD123	32	2.03	0.18	8.70	2.00	3.00
POT	POT	32	5.44	0.87	15.95	4.00	8.50
POT123	POT123	32	2.06	0.25	11.92	2.00	3.00
CL	CL	32	108.63	2.54	2.34	103.00	112.00
CL123	CL123	32	2.00	0.00	0.00	2.00	2.00
CAL	CAL	32	10.00	0.43	4.35	9.00	11.10
CAL123	CAL123	32	2.09	0.30	14.14	2.00	3.00
PHOS	PHOS	32	10.06	17.20	171.04	4.80	104.00
PHOS123	PHOS123	32	2.03	0.18	8.70	2.00	3.00
MG	MG	32	2.34	0.22	9.45	1.90	2.86
MG123	MG123	32	2.56	0.50	19.67	2.00	3.00
TCO2	TCO2	32	27.54	3.76	13.65	16.70	32.30
TCO2123	TCO2123	32	1.91	0.30	15.54	1.00	2.00
SDH	SDH	32	6.25	5.84	93.35	0.70	35.10
SDH123	SDH123	32	2.00	0.25	12.70	1.00	3.00
ANIONGAP	ANIONGAP	32	19.56	4.33	22.15	14.00	33.00

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Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
AG123	AG123	32	2.03	0.31	15.24	1.00	3.00
TOTWBC	TOTWBC	31	16171	5296.2	32.75	1800.0	25100
WBC123	WBC123	31	2.03	0.48	23.71	1.00	3.00
DIFNEUT	DIFNEUT	31	49.77	12.59	25.30	25.00	82.00
DIFNE123	DIFNE123	31	2.16	0.37	17.30	2.00	3.00
DIFBANDS	DIFBANDS	1	1.00	.	.	1.00	1.00
DIFB123	DIFB123	1	3.00	.	.	3.00	3.00
DIFMYEL	DIFMYEL	4	7.75	11.50	148.39	2.00	25.00
DIFLYMPH	DIFLYMPH	30	37.33	13.11	35.12	6.00	67.00
DIFLY123	DIFLY123	30	1.83	0.38	20.68	1.00	2.00
DIFMONO	DIFMONO	28	4.04	3.08	76.44	0.00	14.00
DIFMO123	DIFMO123	28	2.14	0.36	16.63	2.00	3.00
DIFEOSIN	DIFEOSIN	30	7.13	4.67	65.42	1.00	18.00
DIFEO123	DIFEO123	30	2.00	0.00	0.00	2.00	2.00

DIFBASO	DIFBASO	7	2.71	3.68	135.72	1.00	11.00
DIFBA123	DIFBA123	7	2.14	0.38	17.64	2.00	3.00
NEUT	NEUT	31	7965.1	3341.2	41.95	882.00	16750
NEUT123	NEUT123	31	1.90	0.40	20.82	1.00	3.00
BANDS	BANDS	7	237.14	96.96	40.89	109.00	340.00
BANDS123	BANDS123	6	2.67	0.52	19.36	2.00	3.00
LYMPHOCY	LYMPHOCY	31	5999.4	3482.2	58.04	38.00	14941
LYMPH123	LYMPH123	31	2.52	0.57	22.65	1.00	3.00
MONOCYTE	MONOCYTE	28	625.64	493.26	78.84	0.00	2112.0
MONO123	MONO123	28	2.14	0.36	16.63	2.00	3.00
EOSINPHI	EOSINPHI	30	1259.3	1077.1	85.54	36.00	4518.0
EOSIN123	EOSIN123	30	1.77	0.43	24.35	1.00	2.00
BASOPHIL	BASOPHIL	9	322.89	531.94	164.74	1.00	1727.0
BASO123	BASO123	8	2.13	0.35	16.64	2.00	3.00
RBC	RBC	31	15.82	2.67	16.87	9.88	20.00
RBC123	RBC123	31	2.29	0.53	23.09	1.00	3.00
HEMOGLO	HEMOGLO	31	14.90	1.91	12.83	10.20	17.90
HGB123	HGB123	31	1.94	0.25	12.90	1.00	2.00
SPUNPCV	SPUNPCV	31	31.85	5.13	16.10	17.00	40.00
PCV123	PCV123	31	1.84	0.37	20.33	1.00	2.00
MCH	MCH	31	9.51	0.83	8.73	7.80	11.30
MCH123	MCH123	31	1.55	0.51	32.67	1.00	2.00
NUCRBC	NUCRBC	13	20.77	64.70	311.52	1.00	236.00
PLATELEC	PLATELEC	17	247.53	134.93	54.51	72.00	520.00
PLATE123	PLATE123	23	1.78	0.60	33.64	1.00	3.00
PLASPRO	PLASPRO	31	6.70	0.41	6.08	5.70	7.50
PPROT123	PPROT123	31	2.03	0.18	8.84	2.00	3.00
FIBRINOG	FIBRINOG	30	226.67	108.07	47.68	100.00	400.00
FIBRI123	FIBRI123	31	1.94	0.25	12.90	1.00	2.00
RBCMO123	RBCMO123	20	2.00	0.00	0.00	2.00	2.00
WBCMO123	WBCMO123	30	2.00	0.00	0.00	2.00	2.00
SE	SE	33	167.97	42.89	25.53	83.00	263.00
SE123	SE123	33	2.42	0.75	30.99	1.00	3.00

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Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
BORON	BORON	33	1.00	0.00	0.00	1.00	1.00
BORON123	BORON123	33	2.00	0.00	0.00	2.00	2.00
CA	CA	33	96.18	3.36	3.49	88.00	106.00
CA123	CA123	33	2.03	0.17	8.57	2.00	3.00
CR	CR	33	0.10	0.00	0.00	0.10	0.10
CR123	CR123	33	2.00	0.00	0.00	2.00	2.00
CU	CU	33	0.46	0.10	21.70	0.18	0.68
CU123	CU123	33	1.97	0.17	8.84	1.00	2.00
FE	FE	33	1.34	0.17	12.82	1.00	1.76
FE123	FE123	33	2.00	0.00	0.00	2.00	2.00
MAG	MAG	33	22.54	1.75	7.77	18.60	26.00
MAG123	MAG123	33	2.06	0.24	11.76	2.00	3.00
PS	PS	33	71.30	14.80	20.75	42.00	112.00
PS123	PS123	33	2.06	0.24	11.76	2.00	3.00
K	K	33	200.85	32.18	16.02	161.00	325.00
K123	K123	33	2.03	0.17	8.57	2.00	3.00
NA	NA	33	3509.7	95.48	2.72	3340.0	3710.0
NA123	NA123	33	2.00	0.00	0.00	2.00	2.00
ZN	ZN	33	0.29	0.12	39.89	0.14	0.63
ZN123	ZN123	33	1.94	0.56	28.65	1.00	3.00

Table 2 (continued). All traits, males only

---------- SEX=M ----------

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
AGE	AGE	30	2.41	0.54	22.57	1.49	3.71
BWKG	BWKG	21	69.82	7.77	11.12	52.16	83.01
HTCM	HTCM	27	89.46	2.97	3.32	82.55	95.25
BCS	BCS	28	5.64	0.96	17.03	4.50	8.00
ADJBLANK	ADJBLANK	28	1.44	0.41	28.80	0.78	2.13
ADJNECKW	ADJNECKW	27	0.65	0.24	37.38	0.03	1.16
ADJBLNEW	ADJBLNEW	28	2.06	0.59	28.72	1.04	3.22
ADJSECWT	ADJSECWT	14	0.56	0.48	85.14	0.05	1.60
ADJTOTFL	ADJTOTFLKG	14	2.51	0.70	28.11	1.44	4.12
AFD	AFD	30	25.40	3.24	12.74	20.70	31.90
SDFD	SDFD	30	5.33	0.90	16.90	3.90	7.90
CVFD	CVFD	30	20.95	1.99	9.48	17.50	25.50
LESS15	LESS15	30	1.01	1.23	121.33	0.00	4.10
CF	CF	30	81.62	14.44	17.69	46.50	98.10
ADJSLMM	ADJSLMM	30	133.22	16.78	12.59	99.73	160.44
CRV	CRV	30	11.48	1.88	16.42	7.80	16.90
AFDBIOP	AFDBIOP	24	26.65	3.97	14.92	20.10	33.90
SPRATIO	SPRATIO	30	7.83	1.79	22.83	4.60	12.20
FD	FD	30	31.74	9.98	31.43	19.30	63.00
SKINTHIC	SKINTHICK	24	2.49	0.43	17.46	1.93	3.76
GROWRAT	GROWRAT	15	0.40	0.06	13.82	0.31	0.47
FLSLRATI	FLSLRATI	23	0.93	0.06	6.09	0.77	0.98
PRIMAFD	PRIMAFD	24	37.46	4.89	13.05	29.40	46.80
PRIMSDFD	PRIMSDFD	24	5.50	1.41	25.69	3.40	8.60
PRIMCVFD	PRIMCVFD	24	14.71	2.94	20.00	10.40	20.00
PRIMMIN	PRIMMIN	24	27.17	3.07	11.32	22.00	35.00
PRIMMAX	PRIMMAX	24	51.83	6.65	12.83	37.00	62.00
PRIMMED	PRIMMED	19	100.00	0.00	0.00	100.00	100.00
SECAFD	SECAFD	24	25.27	3.95	15.62	19.10	31.70
SECSDFD	SECSDFD	24	3.93	0.64	16.41	2.90	5.10
SECCVFD	SECCVFD	24	15.86	2.54	16.00	11.90	21.40
SECMIN	SECMIN	24	15.79	3.69	23.40	8.00	22.00
SECMAX	SECMAX	24	35.75	5.12	14.32	27.00	46.00
SECMED	SECMED	19	62.37	30.29	48.57	1.00	100.00
ADJMFL	ADJMFL	23	146.59	20.06	13.69	98.63	174.40
ADJFLSD	ADJFLSD	23	8.58	7.97	92.84	2.36	36.21
FLCV	FLCV	23	6.80	6.71	98.77	1.30	24.90
ADJFLMIN	ADJFLMIN	23	122.71	29.71	24.21	49.21	168.15
ADJFLMAX	ADJFLMAX	23	160.96	22.16	13.77	103.55	188.26
SCTH	SCTH	10	425.97	82.74	19.42	306.30	542.00

SCL	SCL	11	12.67	1.70	13.39	11.03	16.09
RAWLUSSC	RAWLUSSC	23	1.87	0.46	24.48	1.00	3.00
CLLUSTSC	CLLUSTSC	23	2.00	0.60	30.15	1.00	3.00
DIFFINT	DIFFINT	14	580.64	965.02	166.20	17.00	3244.0
RRL	RRL	14	0.28	0.27	99.41	0.02	0.87
LOCKCON	LOCKCON	23	5.57	1.38	24.72	4.00	8.00
BUN	BUN	27	20.30	5.99	29.52	8.00	33.00
BUN123	BUN123	27	2.04	0.34	16.57	1.00	3.00
CREATINI	CREATINI	27	1.47	0.25	17.00	1.00	2.00

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Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
CREAT123	CREAT123	27	2.19	0.40	18.12	2.00	3.00
GLUCOSE	GLUCOSE	27	129.07	31.17	24.15	94.00	207.00
GLUC123	GLUC123	27	2.19	0.40	18.12	2.00	3.00
TOTPROT	TOTPROT	27	6.52	0.46	7.00	5.20	7.60
TPROT123	TPROT123	27	2.07	0.27	12.87	2.00	3.00
ALBUMIN	ALBUMIN	27	4.09	0.28	6.86	3.30	4.70
ALBUM123	ALBUM123	27	1.96	0.19	9.80	1.00	2.00
TOTBILR	TOTBILR	20	0.10	0.00	0.00	0.10	0.10
BILRU123	BILRU123	27	2.00	0.00	0.00	2.00	2.00
CK	CK	27	183.85	319.20	173.62	59.00	1729.0
CK123	CK123	27	1.96	0.19	9.80	1.00	2.00
GGT	GGT	27	19.41	6.91	35.62	6.00	37.00
GGT123	GGT123	27	1.96	0.19	9.80	1.00	2.00
ASTSGOT	ASTSGOT	27	190.93	34.33	17.98	119.00	265.00
AST123	AST123	27	1.96	0.19	9.80	1.00	2.00
SOD	SOD	27	148.11	1.95	1.32	144.00	153.00
SOD123	SOD123	27	2.00	0.00	0.00	2.00	2.00
POT	POT	27	5.26	0.91	17.39	4.20	7.70
POT123	POT123	27	2.15	0.36	16.85	2.00	3.00
CL	CL	27	107.81	3.39	3.14	97.00	114.00
CL123	CL123	27	1.96	0.19	9.80	1.00	2.00
CAL	CAL	27	9.75	0.38	3.88	8.80	10.50
CAL123	CAL123	27	2.04	0.19	9.45	2.00	3.00
PHOS	PHOS	27	8.98	8.13	90.58	5.20	49.00
PHOS123	PHOS123	27	2.00	0.00	0.00	2.00	2.00
MG	MG	27	2.25	0.17	7.40	1.89	2.53
MG123	MG123	27	2.59	0.50	19.31	2.00	3.00
TCO2	TCO2	27	26.10	3.21	12.31	21.00	32.70
TCO2123	TCO2123	27	1.93	0.47	24.63	1.00	3.00
SDH	SDH	27	5.13	3.21	62.68	0.70	11.60
SDH123	SDH123	27	1.93	0.27	13.86	1.00	2.00
ANIONGAP	ANIONGAP	27	19.44	4.86	25.01	14.00	35.00
AG123	AG123	27	2.04	0.34	16.57	1.00	3.00
TOTWBC	TOTWBC	27	14541	5000.6	34.39	1000.0	24700
WBC123	WBC123	27	1.96	0.34	17.20	1.00	3.00
DIFNEUT	DIFNEUT	27	56.59	10.25	18.11	41.00	80.00
DIFNE123	DIFNE123	27	2.30	0.47	20.26	2.00	3.00
DIFBANDS	DIFBANDS	3	1.00	0.00	0.00	1.00	1.00
DIFB123	DIFB123	3	3.00	0.00	0.00	3.00	3.00
DIFMYEL	DIFMYEL	0	.	.	.	.	.
DIFLYMPH	DIFLYMPH	27	29.56	10.61	35.90	12.00	47.00
DIFLY123	DIFLY123	27	1.52	0.51	33.53	1.00	2.00
DIFMONO	DIFMONO	23	2.61	1.31	50.03	1.00	5.00
DIFMO123	DIFMO123	23	2.00	0.00	0.00	2.00	2.00
DIFEOSIN	DIFEOSIN	27	11.11	7.03	63.31	1.00	30.00
DIFEO123	DIFEO123	27	2.00	0.00	0.00	2.00	2.00
DIFBASO	DIFBASO	2	1.50	0.71	47.14	1.00	2.00
DIFBA123	DIFBA123	2	2.00	0.00	0.00	2.00	2.00
NEUT	NEUT	27	8138.9	3155.8	38.77	580.00	16302
NEUT123	NEUT123	27	1.93	0.38	19.99	1.00	3.00
BANDS	BANDS	7	212.14	127.75	60.22	102.00	459.00
BANDS123	BANDS123	7	2.71	0.49	17.98	2.00	3.00
LYMPHOCY	LYMPHOCY	27	4249.9	2027.1	47.70	320.00	8624.0

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Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
LYMPH123	LYMPH123	27	2.26	0.59	26.31	1.00	3.00
MONOCYTE	MONOCYTE	23	337.09	148.69	44.11	50.00	625.00
MONO123	MONO123	23	2.00	0.00	0.00	2.00	2.00
EOSINPHI	EOSINPHI	27	1788.6	1517.4	84.84	41.00	6120.0
EOSIN123	EOSIN123	27	1.89	0.58	30.57	1.00	3.00
BASOPHIL	BASOPHIL	2	220.50	41.72	18.92	191.00	250.00
BASO123	BASO123	2	2.00	0.00	0.00	2.00	2.00
RBC	RBC	27	14.98	2.13	14.19	11.18	18.69
RBC123	RBC123	27	2.19	0.40	18.12	2.00	3.00
HEMOGLO	HEMOGLO	27	14.26	1.44	10.09	10.80	17.00
HGB123	HGB123	27	1.93	0.27	13.86	1.00	2.00
SPUNPCV	SPUNPCV	27	31.19	4.58	14.68	20.00	40.00
PCV123	PCV123	27	1.85	0.36	19.55	1.00	2.00
MCH	MCH	27	9.60	0.82	8.59	8.20	11.50
MCH123	MCH123	27	1.59	0.50	31.44	1.00	2.00
NUCRBC	NUCRBC	6	1.17	0.41	34.99	1.00	2.00
PLATELEC	PLATELEC	11	352.09	177.39	50.38	75.00	554.00
PLATE123	PLATE123	19	2.00	0.82	40.82	1.00	3.00
PLASPRO	PLASPRO	27	6.60	0.47	7.17	5.50	7.70
PPROT123	PPROT123	27	2.00	0.28	13.87	1.00	3.00
FIBRINOG	FIBRINOG	25	260.00	115.47	44.41	100.00	500.00
FIBRI123	FIBRI123	27	2.00	0.00	0.00	2.00	2.00
RBCMO123	RBCMO123	15	2.00	0.00	0.00	2.00	2.00
WBCMO123	WBCMO123	27	2.00	0.00	0.00	2.00	2.00
SE	SE	22	171.73	27.87	16.23	96.00	214.00
SE123	SE123	22	2.59	0.59	22.78	1.00	3.00
BORON	BORON	28	1.00	0.00	0.00	1.00	1.00
BORON123	BORON123	28	2.00	0.00	0.00	2.00	2.00
CA	CA	28	93.25	3.30	3.53	88.00	100.00
CA123	CA123	28	2.00	0.00	0.00	2.00	2.00
CR	CR	28	0.10	0.00	0.00	0.10	0.10
CR123	CR123	28	2.00	0.00	0.00	2.00	2.00
CU	CU	28	0.46	0.08	16.53	0.16	0.59
CU123	CU123	28	2.00	0.00	0.00	2.00	2.00
FE	FE	28	1.22	0.30	24.57	0.81	1.80
FE123	FE123	28	2.00	0.00	0.00	2.00	2.00
MAG	MAG	28	21.95	1.95	8.89	18.20	27.10
MAG123	MAG123	28	2.00	0.00	0.00	2.00	2.00
PS	PS	28	68.29	14.77	21.63	40.00	101.00
PS123	PS123	28	2.04	0.19	9.28	2.00	3.00
K	K	28	181.68	13.29	7.31	163.00	210.00
K123	K123	28	2.00	0.00	0.00	2.00	2.00
NA	NA	28	3462.9	97.63	2.82	3330.0	3690.0
NA123	NA123	28	2.00	0.00	0.00	2.00	2.00
ZN	ZN	28	0.25	0.12	48.52	0.10	0.66
ZN123	ZN123	28	1.64	0.62	37.83	1.00	3.00

Table 3. Traits that differed significantly ($P < 0.05$) between the sexes.

Variable	Female	Male	*P* value
BWKG	78.3	69.8	0.0082
FD	26.2	31.7	0.0120
RAWLUSSC	1.52	1.87	0.0142
DIFFINT	1483.5	580.6	0.0335
SOD	150.2	148.1	0.0027
CAL	10.00	9.75	0.0259
DIFFNEUT	49.8	56.6	0.0291
LYMPHOCY	5999	4250	0.0256
DIFLYMPH	37.3	29.6	0.0177
DIFMONO	4.04	2.61	0.0439
MONOCYTE	625.6	337.1	0.0094
DIFEOSIN	7.13	11.11	0.0140
CA	96.2	93.3	0.0011
K	200.8	181.7	0.0046

Table 4. All traits, colored animals only

---------- W/C=C ----------

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
AGE	AGE	40	2.39	0.48	20.17	1.49	3.50
BWKG	BWKG	32	73.10	12.37	16.92	52.16	105.23
HTCM	HTCM	34	90.69	3.51	3.87	85.09	99.06
BCS	BCS	34	5.79	0.93	16.06	4.50	8.00
ADJBLANK	ADJBLANK	38	1.40	0.53	37.83	0.44	3.09
ADJNECKW	ADJNECKW	34	0.58	0.23	40.09	0.03	1.13
ADJBLNEW	ADJBLNEW	38	1.92	0.57	29.80	0.72	3.22
ADJSECWT	ADJSECWT	20	0.50	0.41	81.89	0.05	1.60
ADJTOTFL	ADJTOTFLKG	20	2.38	0.80	33.69	0.86	3.83
AFD	AFD	40	26.76	4.95	18.50	19.70	39.60
SDFD	SDFD	40	5.71	1.20	21.01	3.90	9.00
CVFD	CVFD	40	21.31	2.06	9.66	18.30	26.20
LESS15	LESS15	40	0.99	1.53	155.37	0.00	7.60
CF	CF	40	74.33	24.88	33.48	9.60	98.20
ADJSLMM	ADJSLMM	40	131.62	19.48	14.80	78.28	179.93
CRV	CRV	40	11.11	1.86	16.74	7.30	14.20
AFDBIOP	AFDBIOP	36	27.66	4.75	17.16	19.60	41.40
SPRATIO	SPRATIO	39	7.27	1.72	23.72	3.20	11.40
FD	FD	39	26.89	7.70	28.63	11.60	47.60
SKINTHIC	SKINTHICK	36	2.36	0.43	18.22	1.70	3.76
GROWRAT	GROWRAT	29	0.39	0.05	13.27	0.30	0.48
FLSLRATI	FLSLRATI	35	0.93	0.05	5.63	0.77	0.98
PRIMAFD	PRIMAFD	36	38.87	5.48	14.09	29.60	53.60
PRIMSDFD	PRIMSDFD	36	6.01	1.65	27.41	3.40	10.40
PRIMCVFD	PRIMCVFD	36	15.48	3.40	21.98	9.80	26.70
PRIMMIN	PRIMMIN	36	26.78	4.18	15.59	16.00	33.00
PRIMMAX	PRIMMAX	36	54.08	8.19	15.14	37.00	78.00
PRIMMED	PRIMMED	30	99.93	0.37	0.37	98.00	100.00
SECAFD	SECAFD	36	26.22	4.74	18.07	18.60	39.90
SECSDFD	SECSDFD	36	4.20	1.05	25.10	3.10	8.50
SECCVFD	SECCVFD	36	16.39	3.84	23.45	11.30	31.30
SECMIN	SECMIN	36	16.78	4.61	27.45	8.00	30.00
SECMAX	SECMAX	36	38.22	8.35	21.85	27.00	64.00
SECMED	SECMED	30	65.67	30.44	46.36	8.00	100.00
ADJMFL	ADJMFL	35	142.95	21.26	14.87	98.63	187.39
ADJFLSD	ADJFLSD	35	9.70	8.99	92.67	2.87	36.21
FLCV	FLCV	35	7.23	6.46	89.27	1.90	24.90
ADJFLMIN	ADJFLMIN	35	117.81	27.89	23.67	49.21	165.57
ADJFLMAX	ADJFLMAX	35	156.15	26.24	16.81	103.55	205.70
SCTH	SCTH	13	408.16	83.44	20.44	297.00	542.00
SCL	SCL	19	12.71	1.61	12.68	10.77	16.09
RAWLUSSC	RAWLUSSC	29	1.55	0.51	32.62	1.00	2.00
CLLUSTSC	CLLUSTSC	29	1.83	0.60	32.92	1.00	3.00
DIFFINT	DIFFINT	29	887.14	1121.2	126.38	17.00	3448.0
RRL	RRL	29	0.22	0.26	114.87	0.02	0.87

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
LOCKCON	LOCKCON	29	5.21	1.15	22.01	3.00	8.00
BUN	BUN	36	20.03	5.19	25.92	11.00	33.00
BUN123	BUN123	36	2.06	0.23	11.30	2.00	3.00
CREATINI	CREATINI	36	1.56	0.30	19.40	1.00	2.30
CREAT123	CREAT123	36	2.19	0.40	18.29	2.00	3.00
GLUCOSE	GLUCOSE	36	123.47	34.85	28.22	9.00	202.00
GLUC123	GLUC123	36	2.14	0.49	22.78	1.00	3.00
TOTPROT	TOTPROT	36	6.53	0.43	6.66	5.20	7.40
TPROT123	TPROT123	36	2.19	0.40	18.29	2.00	3.00
ALBUMIN	ALBUMIN	36	5.35	6.97	130.30	3.30	46.00
ALBUM123	ALBUM123	36	1.97	0.17	8.45	1.00	2.00
TOTBILR	TOTBILR	32	0.10	0.00	0.00	0.10	0.10
BILRU123	BILRU123	36	2.00	0.00	0.00	2.00	2.00

CK	CK	36	177.67	303.19	170.65	32.00	1729.0
CK123	CK123	36	1.97	0.29	14.78	1.00	3.00
GGT	GGT	36	19.44	5.93	30.47	6.00	30.00
GGT123	GGT123	36	1.94	0.23	11.95	1.00	2.00
ASTSGOT	ASTSGOT	36	196.69	77.11	39.20	113.00	592.00
AST123	AST123	36	2.00	0.24	11.95	1.00	3.00
SOD	SOD	36	149.17	2.98	2.00	144.00	158.00
SOD123	SOD123	36	2.03	0.17	8.22	2.00	3.00
POT	POT	36	5.39	0.97	18.05	4.00	8.50
POT123	POT123	36	2.11	0.32	15.10	2.00	3.00
CL	CL	36	107.89	3.34	3.09	97.00	114.00
CL123	CL123	36	1.97	0.17	8.45	1.00	2.00
CAL	CAL	36	9.83	0.42	4.32	9.00	11.10
CAL123	CAL123	36	2.03	0.17	8.22	2.00	3.00
PHOS	PHOS	36	10.19	16.15	158.59	4.80	104.00
PHOS123	PHOS123	36	2.03	0.17	8.22	2.00	3.00
MG	MG	36	2.35	0.20	8.60	2.03	2.86
MG123	MG123	36	2.58	0.50	19.35	2.00	3.00
TCO2	TCO2	36	27.01	3.36	12.45	18.70	32.70
TCO2123	TCO2123	36	1.92	0.44	22.91	1.00	3.00
SDH	SDH	36	5.07	2.91	57.48	0.70	12.30
SDH123	SDH123	36	1.92	0.28	14.62	1.00	2.00
ANIONGAP	ANIONGAP	36	19.67	4.63	23.54	14.00	35.00
AG123	AG123	36	2.00	0.34	16.90	1.00	3.00
TOTWBC	TOTWBC	35	14783	6022.0	40.74	1000.0	25000
WBC123	WBC123	35	1.94	0.48	24.79	1.00	3.00
DIFNEUT	DIFNEUT	35	53.23	13.90	26.12	25.00	82.00
DIFNE123	DIFNE123	35	2.26	0.44	19.65	2.00	3.00
DIFBANDS	DIFBANDS	3	1.00	0.00	0.00	1.00	1.00
DIFB123	DIFB123	3	3.00	0.00	0.00	3.00	3.00
DIFMYEL	DIFMYEL	4	7.75	11.50	148.39	2.00	25.00
DIFLYMPH	DIFLYMPH	34	34.29	14.41	42.01	6.00	67.00

---------- WC=C ----------

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
DIFLY123	DIFLY123	34	1.68	0.47	28.32	1.00	2.00
DIFMONO	DIFMONO	30	3.53	2.53	71.57	1.00	14.00
DIFMO123	DIFMO123	30	2.07	0.25	12.28	2.00	3.00
DIFEOSIN	DIFEOSIN	34	7.82	6.31	80.69	1.00	30.00
DIFEO123	DIFEO123	34	2.00	0.00	0.00	2.00	2.00
DIFBASO	DIFBASO	7	2.71	3.68	135.72	1.00	11.00
DIFBA123	DIFBA123	7	2.14	0.38	17.64	2.00	3.00
NEUT	NEUT	35	7704.0	3796.2	49.28	580.00	16750
NEUT123	NEUT123	35	1.89	0.47	24.98	1.00	3.00
BANDS	BANDS	7	154.86	63.63	41.09	102.00	286.00
BANDS123	BANDS123	6	2.33	0.52	22.13	2.00	3.00
LYMPHOCY	LYMPHOCY	35	5013.0	3507.0	69.96	38.00	14941
LYMPH123	LYMPH123	35	2.29	0.62	27.20	1.00	3.00
MONOCYTE	MONOCYTE	30	478.17	377.23	78.89	50.00	2002.0
MONO123	MONO123	30	2.10	0.31	14.53	2.00	3.00
EOSINPHI	EOSINPHI	34	1326.5	1429.8	107.79	36.00	6120.0
EOSIN123	EOSIN123	34	1.71	0.58	33.94	1.00	3.00
BASOPHIL	BASOPHIL	9	330.78	528.11	159.66	1.00	1727.0
BASO123	BASO123	8	2.13	0.35	16.64	2.00	3.00
RBC	RBC	35	15.58	2.59	16.65	9.88	20.00
RBC123	RBC123	35	2.26	0.51	22.39	1.00	3.00
HEMOGLO	HEMOGLO	35	14.58	1.83	12.53	10.20	17.90
HGB123	HGB123	35	1.94	0.24	12.12	1.00	2.00
SPUNPCV	SPUNPCV	35	31.09	4.96	15.94	17.00	40.00

PCV123	PCV123	35	1.86	0.36	19.12	1.00	2.00
MCH	MCH	35	9.45	0.82	8.67	8.10	11.10
MCH123	MCH123	35	1.46	0.51	34.69	1.00	2.00
NUCRBC	NUCRBC	15	17.60	60.43	343.37	1.00	236.00
PLATELEC	PLATELEC	17	310.06	170.59	55.02	72.00	554.00
PLATE123	PLATE123	24	1.96	0.75	38.33	1.00	3.00
PLASPRO	PLASPRO	35	6.56	0.44	6.73	5.50	7.50
PPROT123	PPROT123	35	2.00	0.24	12.13	1.00	3.00
FIBRINOG	FIBRINOG	32	237.50	123.78	52.12	100.00	500.00
FIBRI123	FIBRI123	35	1.94	0.24	12.12	1.00	2.00
RBCMO123	RBCMO123	20	2.00	0.00	0.00	2.00	2.00
WBCMO123	WBCMO123	34	2.00	0.00	0.00	2.00	2.00
SE	SE	36	172.72	32.44	18.78	116.00	263.00
SE123	SE123	36	2.58	0.65	25.13	1.00	3.00
BORON	BORON	38	1.00	0.00	0.00	1.00	1.00
BORON123	BORON123	38	2.00	0.00	0.00	2.00	2.00
CA	CA	38	94.66	3.79	4.01	88.00	106.00
CA123	CA123	38	2.03	0.16	8.01	2.00	3.00
CR	CR	38	0.10	0.00	0.00	0.10	0.10
CR123	CR123	38	2.00	0.00	0.00	2.00	2.00
CU	CU	38	0.46	0.11	23.04	0.16	0.68

---------- W/C=C ----------

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
CU123	CU123	38	1.97	0.16	8.22	1.00	2.00
FE	FE	38	1.29	0.28	21.53	0.81	1.80
FE123	FE123	38	2.00	0.00	0.00	2.00	2.00
MAG	MAG	38	22.63	1.79	7.89	19.60	27.10
MAG123	MAG123	38	2.05	0.23	11.02	2.00	3.00
PS	PS	38	73.37	15.88	21.64	42.00	112.00
PS123	PS123	38	2.08	0.27	13.14	2.00	3.00
K	K	38	190.53	28.22	14.81	161.00	325.00
K123	K123	38	2.03	0.16	8.01	2.00	3.00
NA	NA	38	3493.7	99.55	2.85	3340.0	3710.0
NA123	NA123	38	2.00	0.00	0.00	2.00	2.00
ZN	ZN	38	0.28	0.13	47.35	0.12	0.66
ZN123	ZN123	38	1.82	0.65	35.89	1.00	3.00

Table 4 (continued). All traits, white animals only

---------- W/C=W ----------

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
AGE	AGE	23	2.31	0.51	22.03	1.76	3.71
BWKG	BWKG	18	77.65	9.11	11.73	65.09	96.16
HTCM	HTCM	22	88.87	3.17	3.57	82.55	95.89
BCS	BCS	23	6.00	0.95	15.89	5.00	8.00
ADJBLANK	ADJBLANK	23	1.62	0.41	25.12	0.84	2.29
ADJNECKW	ADJNECKW	23	0.68	0.20	28.88	0.40	1.16
ADJBLNEW	ADJBLNEW	23	2.30	0.54	23.43	1.31	3.22
ADJSECWT	ADJSECWT	15	0.79	0.39	49.41	0.09	1.42
ADJTOTFL	ADJTOTFLKG	15	2.97	0.72	24.13	1.80	4.12
AFD	AFD	23	24.91	2.89	11.58	21.10	31.90
SDFD	SDFD	23	4.98	0.56	11.31	4.30	6.00
CVFD	CVFD	23	20.04	1.79	8.92	16.50	23.10
LESS15	LESS15	23	0.88	0.91	103.73	0.00	3.20
CF	CF	23	84.32	12.96	15.37	46.50	96.10
ADJSLMM	ADJSLMM	23	143.83	19.76	13.74	99.73	174.85
CRV	CRV	23	11.69	1.67	14.26	8.70	16.90
AFDBIOP	AFDBIOP	19	25.88	4.03	15.58	21.80	32.90
SPRATIO	SPRATIO	22	8.35	2.00	23.95	4.60	12.50
FD	FD	23	32.28	9.61	29.78	19.40	63.00
SKINTHIC	SKINTHICK	19	2.50	0.35	13.84	1.93	3.48
GROWRAT	GROWRAT	11	0.46	0.05	11.89	0.35	0.56
FLSLRATI	FLSLRATI	19	0.95	0.03	3.08	0.87	0.98
PRIMAFD	PRIMAFD	19	35.69	5.23	14.66	28.10	45.30
PRIMSDFD	PRIMSDFD	19	5.41	1.86	34.36	2.60	11.10
PRIMCVFD	PRIMCVFD	19	15.19	4.47	29.45	8.50	28.80
PRIMMIN	PRIMMIN	19	26.26	3.75	14.29	20.00	35.00
PRIMMAX	PRIMMAX	19	51.42	8.84	17.19	36.00	74.00
PRIMMED	PRIMMED	19	99.68	1.38	1.38	94.00	100.00
SECAFD	SECAFD	19	24.82	3.97	16.01	20.50	32.20
SECSDFD	SECSDFD	18	3.83	0.73	19.13	2.80	5.40
SECCVFD	SECCVFD	19	15.62	2.01	12.86	12.50	19.20
SECMIN	SECMIN	19	15.42	2.97	19.25	10.00	22.00
SECMAX	SECMAX	19	34.16	5.11	14.97	28.00	42.00
SECMED	SECMED	19	49.95	32.95	65.98	1.00	100.00
ADJMFL	ADJMFL	19	165.12	17.42	10.55	130.66	205.56
ADJFLSD	ADJFLSD	19	8.44	6.09	72.13	2.36	23.39
FLCV	FLCV	19	5.13	3.63	70.90	1.30	14.00
ADJFLMIN	ADJFLMIN	19	142.66	23.80	16.68	92.41	174.30
ADJFLMAX	ADJFLMAX	19	178.87	20.49	11.46	144.00	233.86
SCTH	SCTH	7	472.50	83.42	17.65	383.30	608.00
SCL	SCL	10	14.05	2.03	14.44	11.07	18.06
RAWLUSSC	RAWLUSSC	21	1.86	0.48	25.74	1.00	3.00
CLLUSTSC	CLLUSTSC	21	2.19	0.68	31.03	1.00	3.00
DIFFINT	DIFFINT	4	2647.3	738.92	27.91	1808.0	3396.0
RRL	RRL	4	0.02	0.00	7.79	0.02	0.02
LOCKCON	LOCKCON	21	5.95	1.24	20.90	4.00	8.00
BUN	BUN	23	18.87	4.69	24.87	8.00	27.00
BUN123	BUN123	23	1.96	0.21	10.66	1.00	2.00
CREATINI	CREATINI	23	1.54	0.33	21.20	1.10	2.40

---------- WC=W ----------

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
CREAT123	CREAT123	23	2.22	0.42	19.02	2.00	3.00
GLUCOSE	GLUCOSE	23	126.83	26.34	20.77	100.00	207.00
GLUC123	GLUC123	23	2.13	0.34	16.16	2.00	3.00
TOTPROT	TOTPROT	23	6.73	0.35	5.17	5.90	7.60
TPROT123	TPROT123	23	2.17	0.39	17.83	2.00	3.00
ALBUMIN	ALBUMIN	23	4.29	0.23	5.46	3.90	4.70
ALBUM123	ALBUM123	23	2.00	0.00	0.00	2.00	2.00
TOTBILR	TOTBILR	19	0.10	0.00	0.00	0.10	0.10
BILRU123	BILRU123	23	2.00	0.00	0.00	2.00	2.00
CK	CK	23	150.48	120.49	80.07	58.00	446.00
CK123	CK123	23	2.00	0.00	0.00	2.00	2.00
GGT	GGT	23	20.65	8.56	41.44	10.00	41.00
GGT123	GGT123	23	2.04	0.21	10.20	2.00	3.00
ASTSGOT	ASTSGOT	23	192.22	59.86	31.14	119.00	423.00
AST123	AST123	23	2.00	0.30	15.08	1.00	3.00
SOD	SOD	23	149.39	2.44	1.64	146.00	154.00
SOD123	SOD123	23	2.00	0.00	0.00	2.00	2.00
POT	POT	23	5.31	0.75	14.13	4.30	6.70
POT123	POT123	23	2.09	0.29	13.80	2.00	3.00
CL	CL	23	108.83	2.19	2.01	104.00	113.00
CL123	CL123	23	2.00	0.00	0.00	2.00	2.00
CAL	CAL	23	9.97	0.42	4.21	8.80	10.70
CAL123	CAL123	23	2.13	0.34	16.16	2.00	3.00
PHOS	PHOS	23	8.59	8.89	103.49	5.20	49.00
PHOS123	PHOS123	23	2.00	0.00	0.00	2.00	2.00
MG	MG	23	2.22	0.18	7.91	1.89	2.53
MG123	MG123	23	2.57	0.51	19.76	2.00	3.00
TCO2	TCO2	23	26.68	3.93	14.74	16.70	32.30
TCO2123	TCO2123	23	1.91	0.29	15.06	1.00	2.00
SDH	SDH	23	6.79	6.76	99.58	2.30	35.10
SDH123	SDH123	23	2.04	0.21	10.20	2.00	3.00
ANIONGAP	ANIONGAP	23	19.26	4.49	23.34	15.00	33.00
AG123	AG123	23	2.09	0.29	13.80	2.00	3.00
TOTWBC	TOTWBC	23	16370	3451.3	21.08	9400.0	25100
WBC123	WBC123	23	2.09	0.29	13.80	2.00	3.00
DIFNEUT	DIFNEUT	23	52.52	8.48	16.14	36.00	72.00
DIFNE123	DIFNE123	23	2.17	0.39	17.83	2.00	3.00
DIFBANDS	DIFBANDS	1	1.00	.	.	1.00	1.00
DIFB123	DIFB123	1	3.00	.	.	3.00	3.00
DIFMYEL	DIFMYEL	0	.	.	.	.	.
DIFLYMPH	DIFLYMPH	23	32.70	9.26	28.32	12.00	48.00
DIFLY123	DIFLY123	23	1.70	0.47	27.75	1.00	2.00
DIFMONO	DIFMONO	21	3.19	2.58	80.90	0.00	12.00
DIFMO123	DIFMO123	21	2.10	0.30	14.36	2.00	3.00
DIFEOSIN	DIFEOSIN	23	10.78	5.67	52.61	1.00	24.00
DIFEO123	DIFEO123	23	2.00	0.00	0.00	2.00	2.00
DIFBASO	DIFBASO	2	1.50	0.71	47.14	1.00	2.00
DIFBA123	DIFBA123	2	2.00	0.00	0.00	2.00	2.00
NEUT	NEUT	23	8566.3	2066.8	24.13	4512.0	12060
NEUT123	NEUT123	23	1.96	0.21	10.66	1.00	2.00
BANDS	BANDS	7	294.43	103.31	35.09	156.00	459.00

---------- WC=W ----------

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
BANDS123	BANDS123	7	3.00	0.00	0.00	3.00	3.00
LYMPHOCY	LYMPHOCY	23	5446.6	2067.0	37.95	1932.0	10542
LYMPH123	LYMPH123	23	2.57	0.51	19.76	2.00	3.00
MONOCYTE	MONOCYTE	21	520.29	444.88	85.51	0.00	2112.0
MONO123	MONO123	21	2.05	0.22	10.66	2.00	3.00
EOSINPHI	EOSINPHI	23	1781.2	1111.7	62.42	171.00	4518.0
EOSIN123	EOSIN123	23	2.00	0.30	15.08	1.00	3.00

BASOPHIL	BASOPHIL	2	185.00	128.69	69.56	94.00	276.00
BASO123	BASO123	2	2.00	0.00	0.00	2.00	2.00
RBC	RBC	23	15.21	2.25	14.76	11.18	20.00
RBC123	RBC123	23	2.22	0.42	19.02	2.00	3.00
HEMOGLO	HEMOGLO	23	14.64	1.59	10.87	11.30	17.50
HGB123	HGB123	23	1.91	0.29	15.06	1.00	2.00
SPUNPCV	SPUNPCV	23	32.24	4.70	14.58	24.00	40.00
PCV123	PCV123	23	1.83	0.39	21.22	1.00	2.00
MCH	MCH	23	9.71	0.82	8.42	7.80	11.50
MCH123	MCH123	23	1.74	0.45	25.82	1.00	2.00
NUCRBC	NUCRBC	4	3.25	3.20	98.51	1.00	8.00
PLATELEC	PLATELEC	11	255.45	139.10	54.45	75.00	480.00
PLATE123	PLATE123	18	1.78	0.65	36.38	1.00	3.00
PLASPRO	PLASPRO	23	6.80	0.40	5.90	6.00	7.70
PPROT123	PPROT123	23	2.04	0.21	10.20	2.00	3.00
FIBRINOG	FIBRINOG	23	247.83	94.72	38.22	100.00	400.00
FIBRI123	FIBRI123	23	2.00	0.00	0.00	2.00	2.00
RBCMO123	RBCMO123	15	2.00	0.00	0.00	2.00	2.00
WBCMO123	WBCMO123	23	2.00	0.00	0.00	2.00	2.00
SE	SE	19	163.32	45.59	27.92	83.00	251.00
SE123	SE123	19	2.32	0.75	32.35	1.00	3.00
BORON	BORON	23	1.00	0.00	0.00	1.00	1.00
BORON123	BORON123	23	2.00	0.00	0.00	2.00	2.00
CA	CA	23	95.13	3.36	3.53	88.00	101.00
CA123	CA123	23	2.00	0.00	0.00	2.00	2.00
CR	CR	23	0.10	0.00	0.00	0.10	0.10
CR123	CR123	23	2.00	0.00	0.00	2.00	2.00
CU	CU	23	0.46	0.05	11.43	0.38	0.55
CU123	CU123	23	2.00	0.00	0.00	2.00	2.00
FE	FE	23	1.27	0.18	14.02	0.85	1.62
FE123	FE123	23	2.00	0.00	0.00	2.00	2.00
MAG	MAG	23	21.67	1.84	8.50	18.20	24.50
MAG123	MAG123	23	2.00	0.00	0.00	2.00	2.00
PS	PS	23	64.22	10.66	16.61	40.00	92.00
PS123	PS123	23	2.00	0.00	0.00	2.00	2.00
K	K	23	194.57	25.03	12.86	165.00	262.00
K123	K123	23	2.00	0.00	0.00	2.00	2.00
NA	NA	23	3479.1	98.30	2.83	3330.0	3690.0
NA123	NA123	23	2.00	0.00	0.00	2.00	2.00
ZN	ZN	23	0.25	0.09	35.74	0.10	0.53
ZN123	ZN123	23	1.78	0.52	29.08	1.00	3.00

Table 5. Traits that differed significantly between colored and white fleeces

Variable	**Colored**	**White**	***P* value**
ADJBLNEW	1.92	2.30	0.0125
ADJSECWT	0.50	0.79	0.0399
ADJTOTFL	2.38	2.97	0.0303
SDFD	5.7	5.0	0.0079
CVFD	21.3	20.0	0.0166
ADJSLMM	131.6	143.8	0.0202
SPRATIO	7.27	8.35	0.0313
FD	26.9	32.3	0.0182

GROWRAT	0.37	0.46	0.0017
PRIMAFD	38.9	35.7	0.0424
ADJMFL	143.0	165.1	0.0003
ADJFLMIN	117.8	142.7	0.0018
ADJFLMAX	156.2	178.9	0.0019
RAWLUSSC	1.55	1.86	0.0362
CLLUSSC	1.83	2.19	0.0519
LOCKCON	5.21	5.95	0.0374
DIFFINT	887.1	2647.3	0.0049
MG	2.35	2.22	0.0146
BANDS	154.9	294.4	0.0102
MAG	22.6	21.7	0.0469
PS	73.4	64.2	0.0174

Because of the uniqueness and novelty of the data, 3 traits will be given further consideration. These are scale length, scale thickness, and luster measurements.

Scale length measurement using scanning electron microscopy

Fiber diameter (N=308) and scale length (N=873) measurements were made on 102 fibers from 29 animals representing both sexes, and all the color groups. In summary, the average diameter, SD, CV, minimum and maximum fiber diameters were 26.1 µm, 6.3 µm, 24.3 %, 13.6 µm, and 44.7 µm, respectively. Corresponding statistics for the scale lengths were: 13.6 µm, 3.0 µm, 21.7 %, 8.6 µm, and 27.2 µm. The correlation coefficient was low (r = 0.33) between scale length and the specific fiber diameter of the fiber on which scale length was measured. In other words, only 10% of the variability in scale length can be explained by the variability in fiber diameter. Note, this is not the same correlation coefficient as the one reported in the main correlation table. This latter correlation coefficient is for scale length versus average fiber diameter of the whole sample. Figures 1 and 2 show typical electron micrographs of alpaca fibers with measurements inscribed on the images by the microscopist.

Figure 1. Electron micrograph of alpaca fiber showing scale measurements.

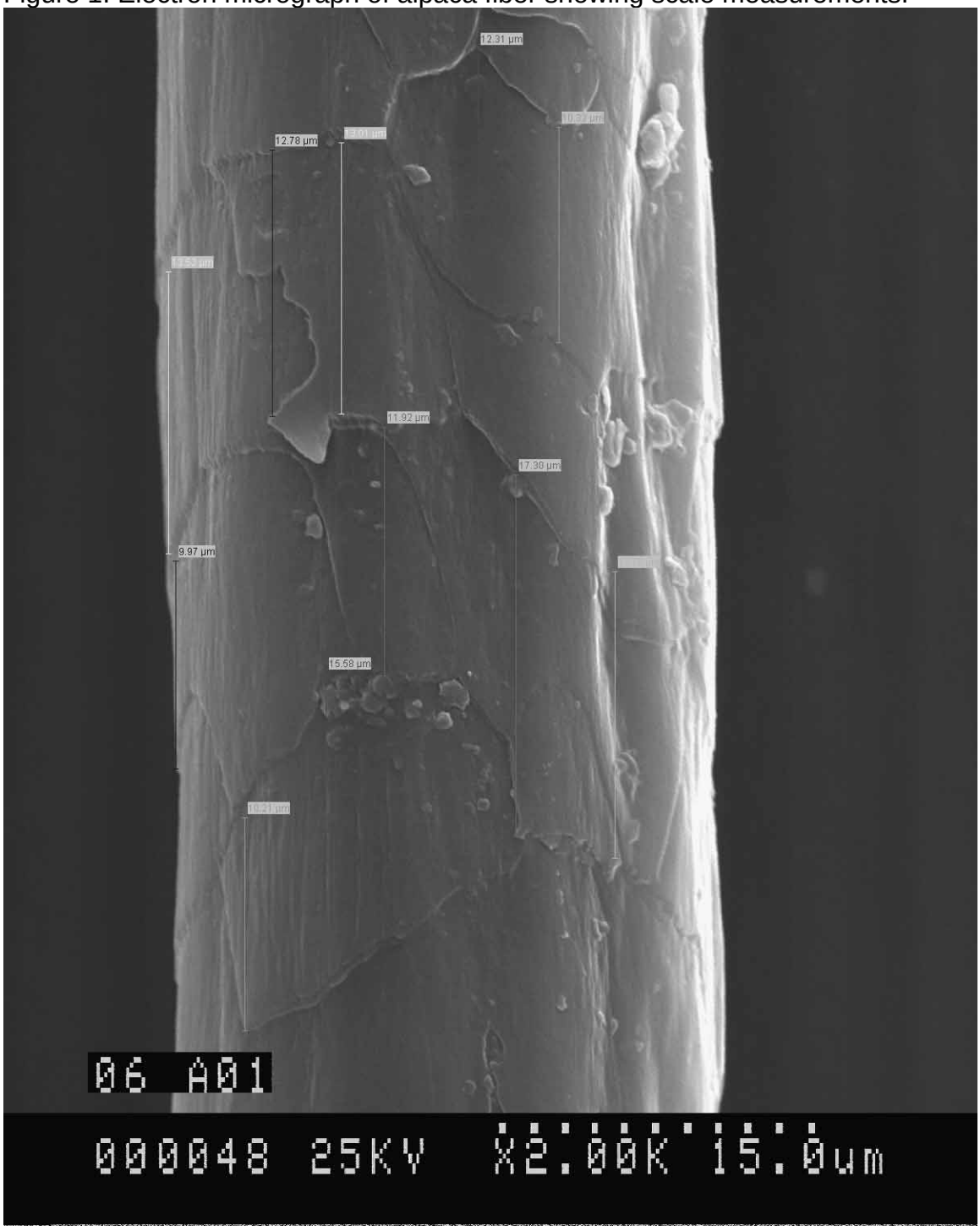
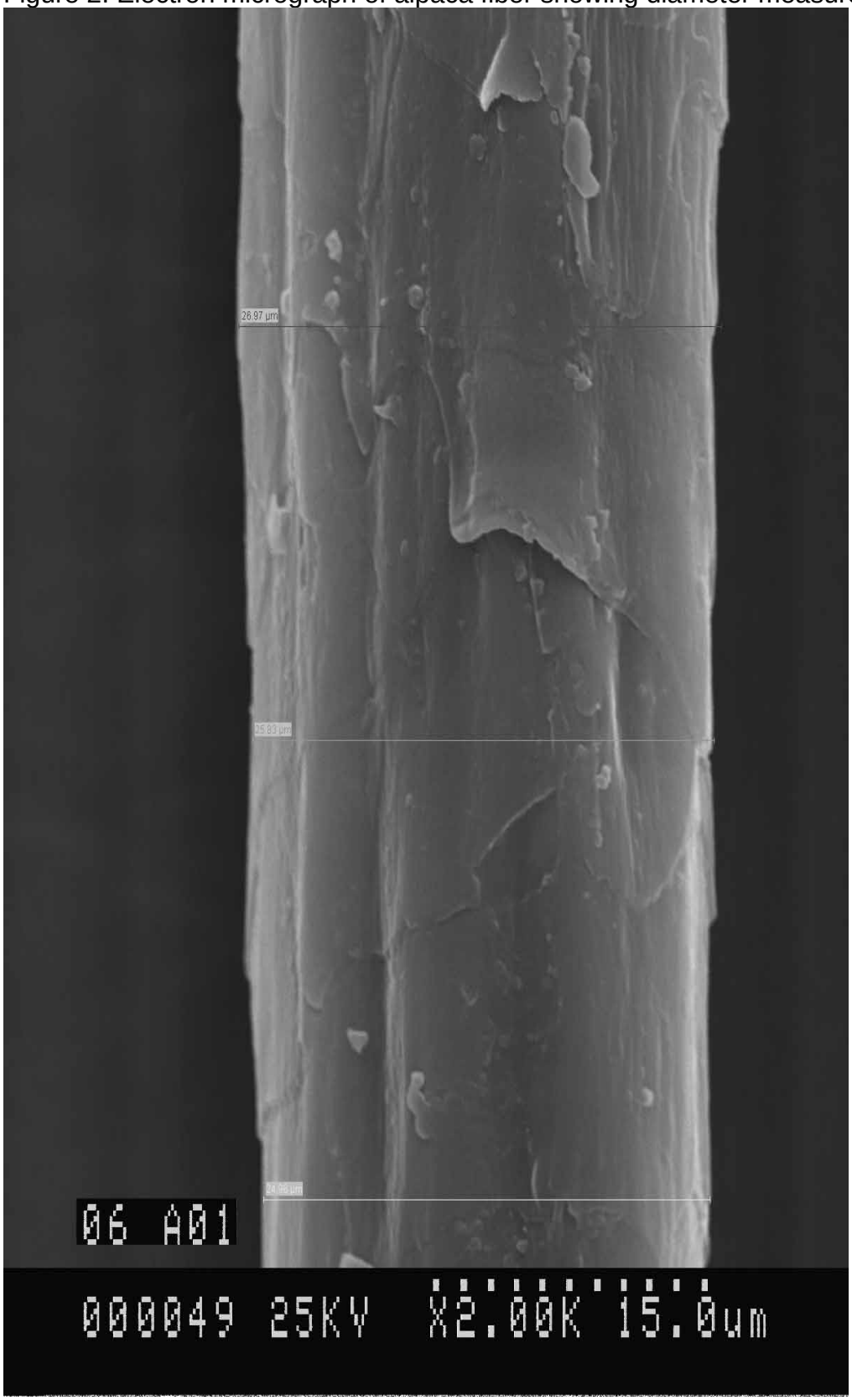


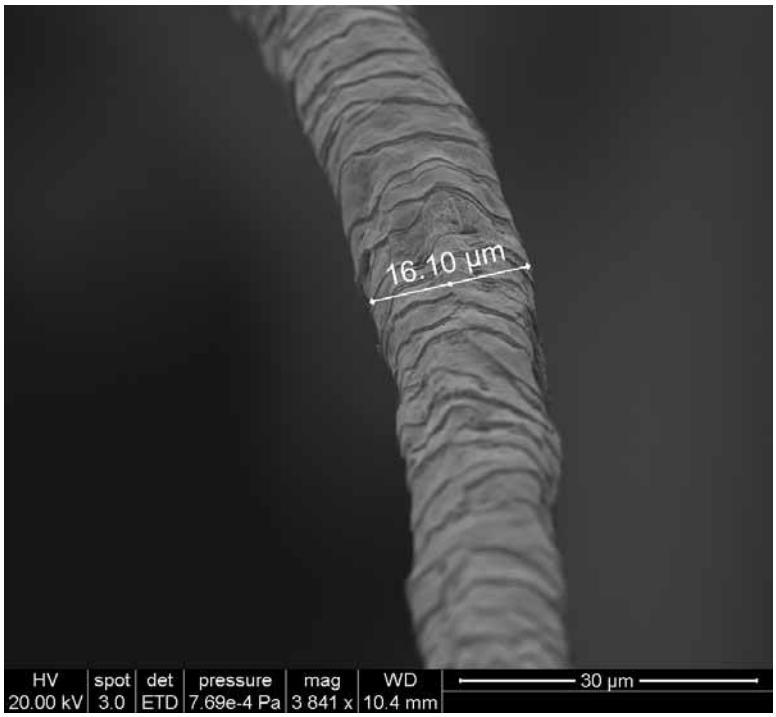
Figure 2. Electron micrograph of alpaca fiber showing diameter measurements.



Scale thickness measurement using scanning electron microscopy

Twenty animals were selected for this part of the study balanced by sex and with representative numbers of white and colored fleeces. Fibers in the diameter range 15 to 40 µm (one fiber per animal) were identified and measured for fiber diameter (n = 20) and associated scale thickness (10 scales per fiber, 5 measurements per scale for a total of 1000 scale thickness measurements. See Figures 3a and 3b for typical examples). In summary, the average scale thickness, SD, CV, minimum and maximum values were: 430.7 nm, 84.9 nm, 19.7%, 297 nm, and 608 nm, respectively. Corresponding values for associated fiber diameters were: 25.5 µm, 6.5 µm, 25.4%, 15.4 µm, and 39.8 µm, respectively. The correlation coefficient between fiber diameter and scale thickness was 0.19. In other words, scale thickness is virtually independent of fiber diameter. The correlation coefficient between scale thickness and scale length was 0.17. As in the previous section, these correlation coefficients are not the same as those reported in the main correlation table.

Figure 3a. Electron micrographs of alpaca fiber showing diameter and scale thickness measurements



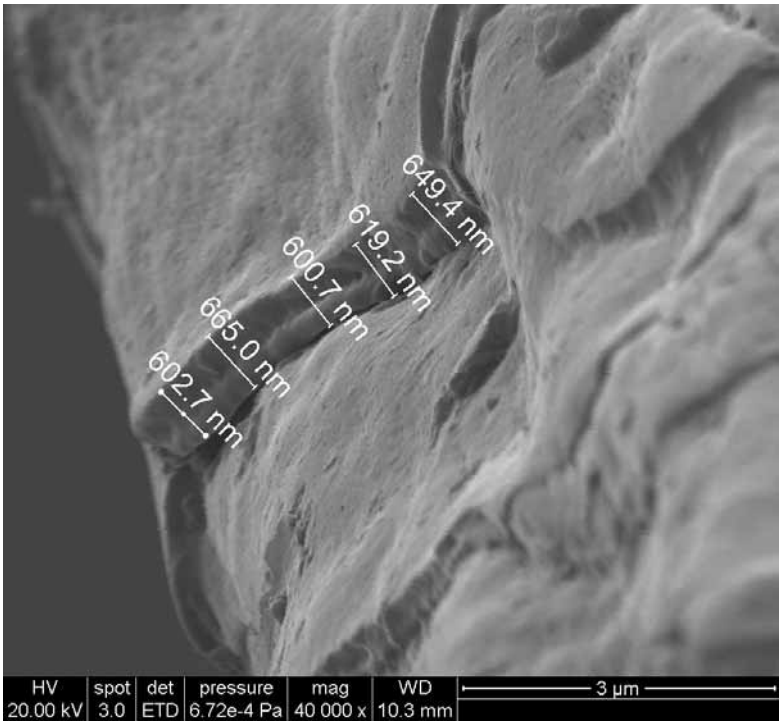
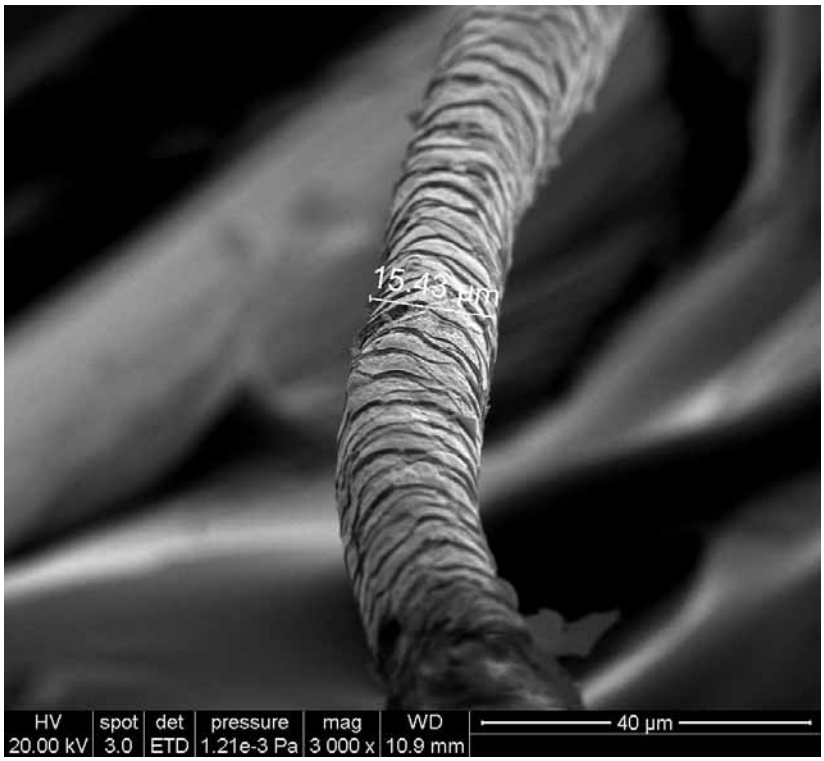
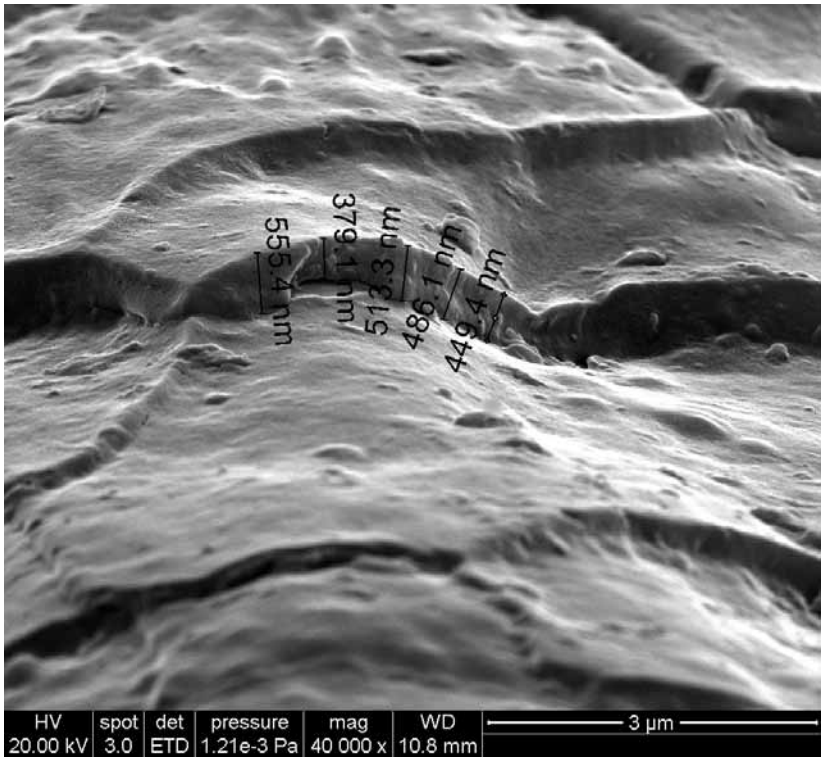


Figure 3b. Electron micrographs of alpaca fiber showing diameter and scale thickness measurements





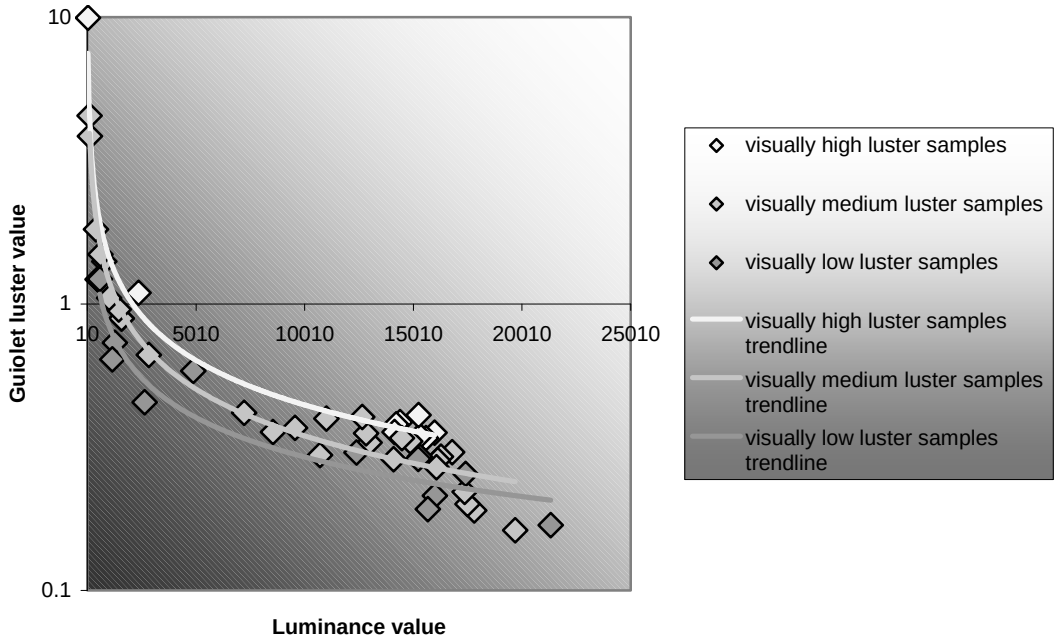
Subjective luster and lock consistency measurements

In addition to all the objective fiber measurements, 3 subjective assessments as well as color were made on the shorn fiber by senior fleece judges. Luster was assigned using a scale of 1-3 (representing low, medium , and high visual luster) on raw (RAWLUSSC) and washed (CLLUSTSC) fiber and lock consistency (LOCKCON) was assigned using a scale of 1 to 10. The means, measures of variation, minimum and maximum values are summarized in the previous tables. The correlations between the RAWLUSSC, CLLUSTSC, LOCKON and AFD were -0.41, -0.34, and -0.25, respectively. Most importantly, however, the CLLUSTSC were used in the validation of the objective luster estimates discussed in the next section.

Luster measurement by Bossa Nova Technolgies (BNT) using the SAMBA instrument

Sixty-five washed Suri alpaca fleece samples were measured for luster and luminance (amount of diffused light) by BNT in the joint study with the Suri Network. In fact numerous raw samples were also measured but these measurements simply indicated that samples must be washed in order to optimize luster. A report was subsequently prepared for the PurelySuri Magazine by N. Lefaudeux, P. Clemenceau, Bill Vonderhaar, and Mary Lou Clingan. It was concluded that for a given color, the instrument data were correlated with the judges' subjective assessments (see Figure 4). Repeatability of the instrument measurement was high when sample preparation was consistent. However, it was concluded that further research was needed to develop a method for objectively measuring luster that is independent of color so that luster of white samples, for example, can be compared directly with luster of darker samples.
Figures

Figure 4. Guiolet luster values versus luminance (Graph courtesy of Nick Lechocinski, Bossa Nova Technologies)



Data for most of these samples were provided to the author of the current report by N. Lechocinski on May 27, 2009 and were analyzed and plotted in numerous different ways (Figures 5a, 5b, 5c, 5d). Recognizing the limitations of most subjective scoring systems (low repeatability within a scorer, poor agreement between scorers, and a tendency for scorers to place most samples in the middle category when only 3 categories are used) and also recognizing the relatively high repeatability for luminance and luster measurement of the SAMBA instrument, it seems reasonable that we should accept the instrument-determined values of luster as being more precise and more accurate than the subjective estimates. This being the case, a relatively simple system for assigning a luster score to instrument-measured samples may be envisioned. First, a much larger number of clean samples representing white, colored, and black fleeces and the 3 visually discernible recognized levels of luster should be measured and plotted as in the Figures 4 or 5. Subsequently, when a test sample is measured for luster and luminance, its visual luster could be estimated by determining its proximity to the nearest trend line.

This simple approach is likely not the answer that most breeders were looking for. Rather they would prefer a method for expressing luster that utilized a continuous scale that would be independent of color so that it could be said with some authority that a particular white sample (for example) is intrinsically more lustrous than a specific black sample. Devising such a measuring system is one of the objectives of a research project currently being conduct by Angus McColl

and the author and being jointly funded by the Alpaca Research Foundation and the Suri Network

Figure 5a. BNT luster versus luminance

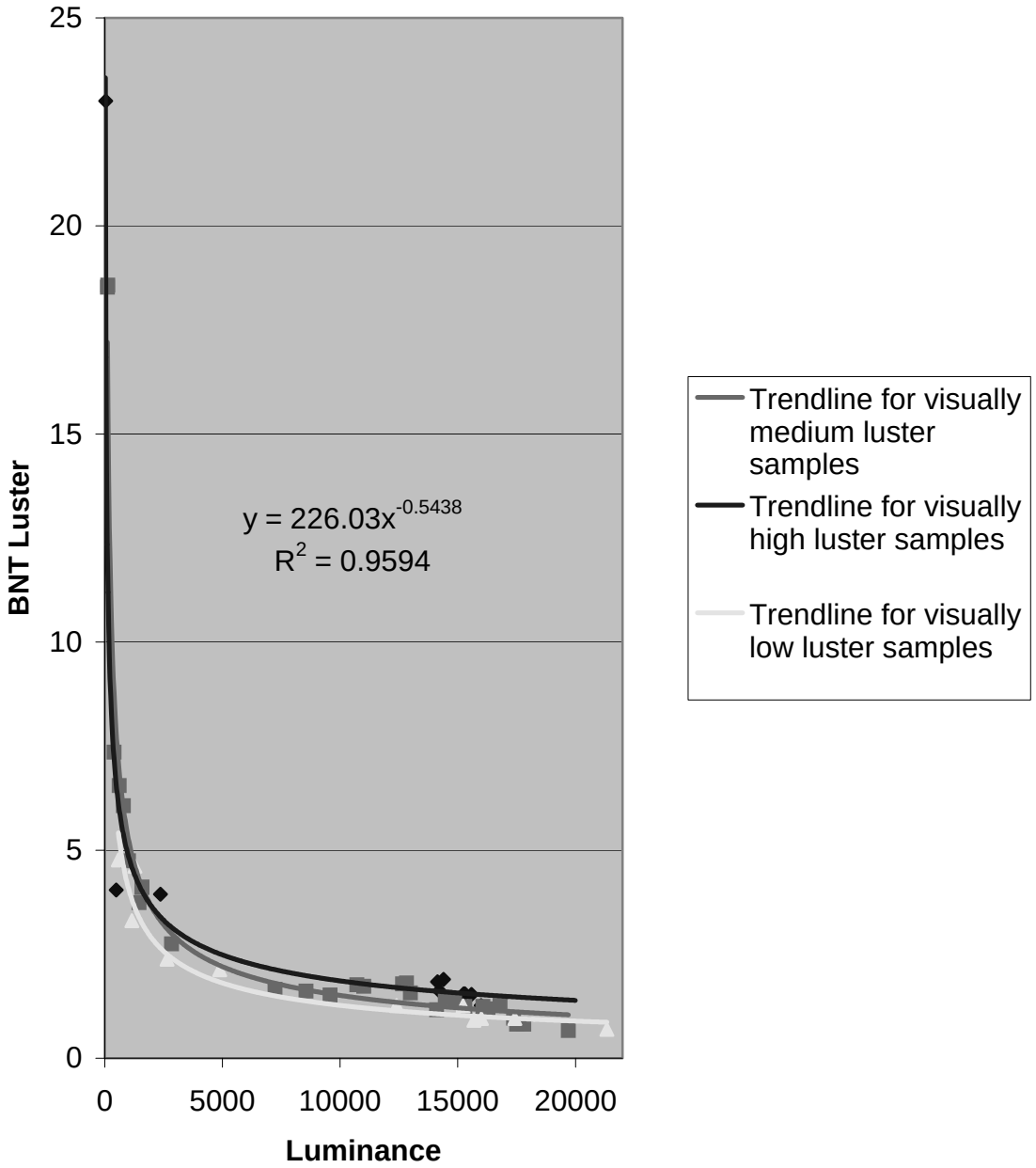


Figure 5b. Guiolet luster versus luminance

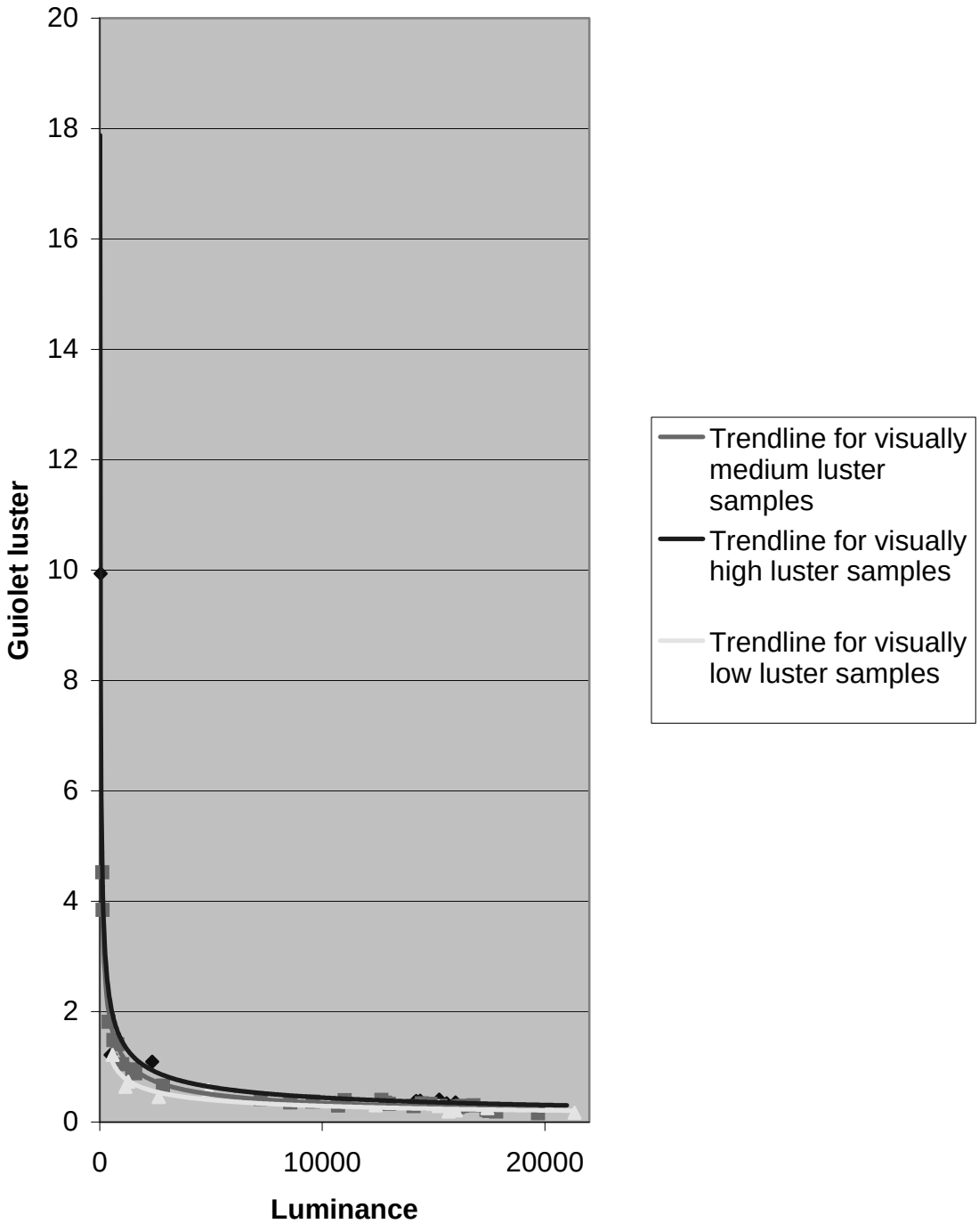


Figure 5c. Reich-Robbins luster versus luminance

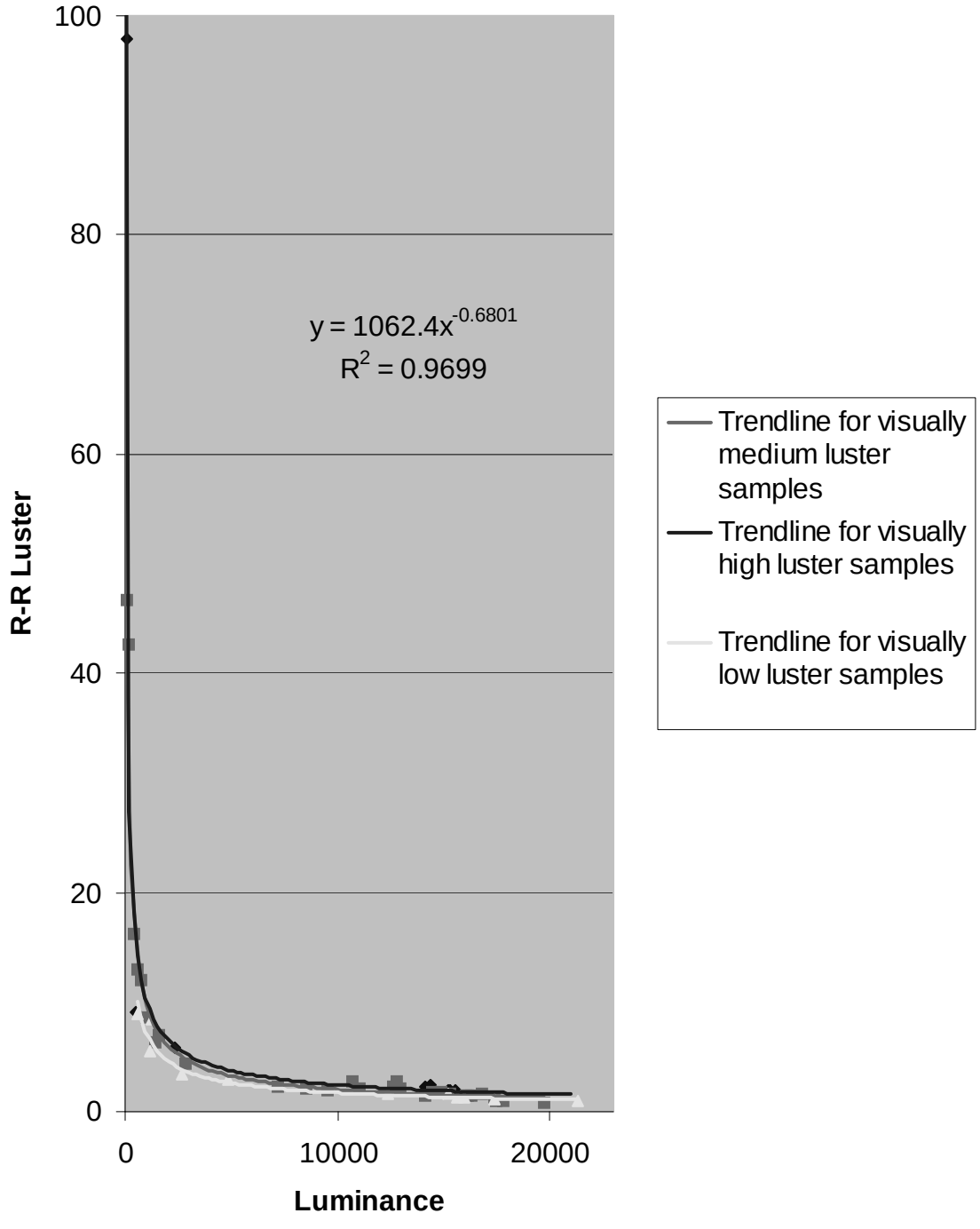
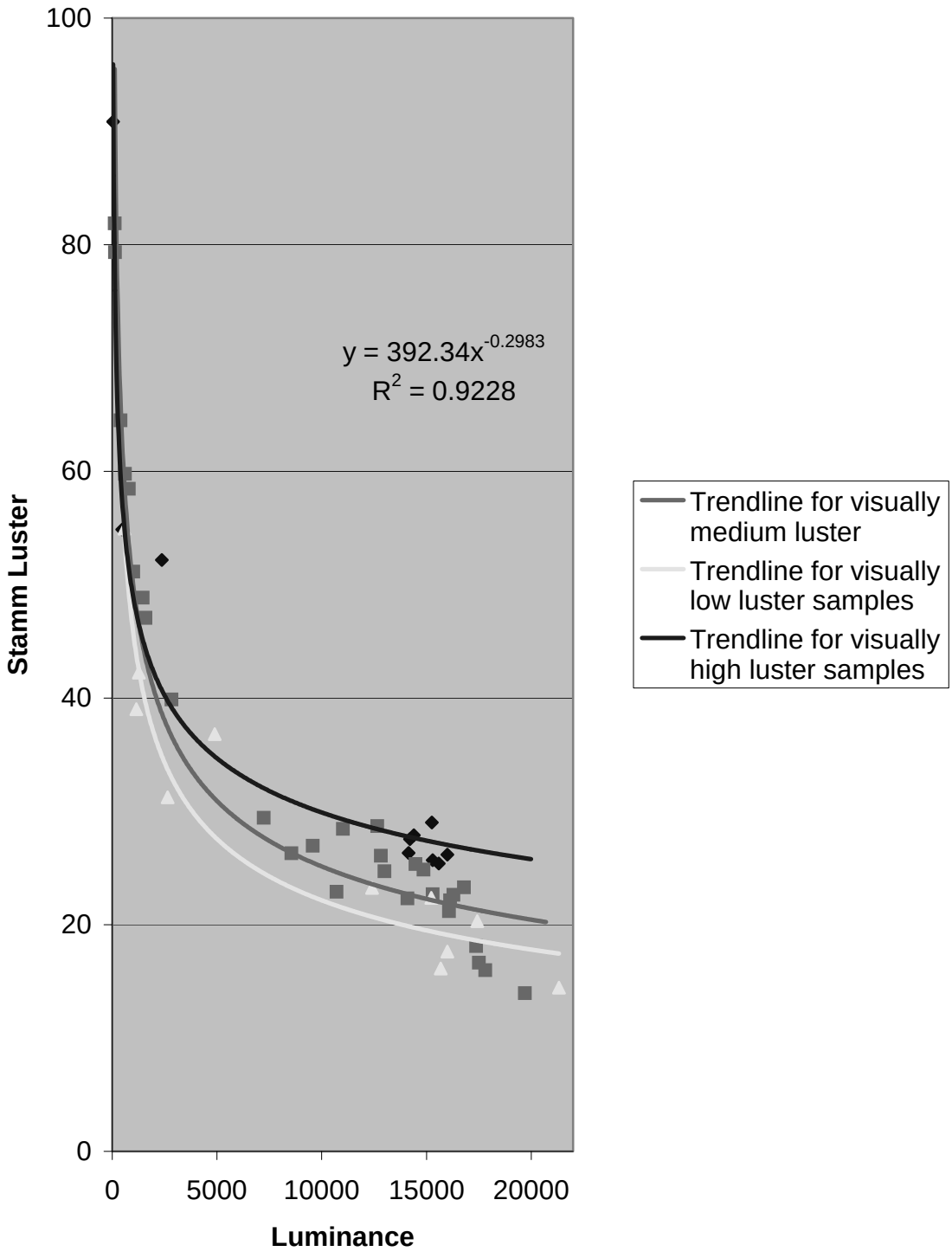


Figure 5d. Stamm luster versus luminance



Correlation analyses

Table 6 is contained in a separate file because it is quite large (117 pages). An attempt was made to calculate Pearson correlation coefficients between all the characteristics that were measured or assessed in this study. In the table, 3 numbers are presented for each correlation. The top number is the correlation coefficient, r. The next number is *P*, the probability value. Correlations with *P* values less than 0.05 are considered to be significant at the 95% probability level. And the third number is N, the number of paired data points used in the correlation analysis. Some of the cells are blank indicating that it was not possible to calculate an r value for that particular pair of traits. Some of the highly significant correlations are intuitive or expected (e.g., SECAFD versus AFD, r = 0.77, $P < 0.0001$ for 55 observations; RRL versus AC, r = -0.51, $P = 0.0024$, for 33 observations) while others were unexpected (at least by the author, (e.g., ALBUMIN versus AFDBIOP, r = 0.44, $P = 0.001$, for 51 observations; CREATINI versus GLUCOSE, r = 0.47, $P = 0.0002$, for 59 observations).

Conclusions

Means, extreme values, and measures of variability have been determined for objectively measured body weight, height at withers, and numerous fiber, skin, and blood characteristics of 2-yr-old male and female Suri alpacas representing a broad cross-section of Suri alpaca genetics. The animals had been maintained under several North American production conditions at 7 diverse locations in the USA. Differences between the sexes and between white and colored animals were reported. In addition, subjective assessments of several traits (i.e., color, lock consistency, and luster) were presented. These summary data are now available to serve as benchmarks for Suri alpaca breeders, veterinarians, fiber specialists, as well as the scientific community in general. Certainly more analyses could be conducted and perhaps further conclusions could be drawn from the data generated in this study. A full correlation analysis incorporating all the traits measured and assessed was also reported but with minimal discussion. Examination of these data reveals many relationships that breeders and veterinarians will find interesting. Much of the Suri alpaca data generated in this study is likely more authoritative than that currently appearing in the scientific literature (e.g., the scale length, scale thickness, objectively measured luster and color data, and the correlations between multiple traits). Nevertheless, some caution is advised when using these data due to the limited number of animals (all 2-year-olds) used in this study.

APPENDIX

Appendix Table 1. All traits, animals from Central location only

---------- LOC=C ----------

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
AGE	AGE	22	2.48	0.61	24.66	1.49	3.71
BWKG	BWKG	9	73.38	10.36	14.12	57.61	90.27
HTCM	HTCM	15	89.24	3.02	3.38	85.09	95.25
BCS	BCS	16	5.38	0.87	16.11	4.50	8.00
ADJBLANK	ADJBLANK	22	1.58	0.62	39.45	0.44	3.09
ADJNECKW	ADJNECKW	18	0.53	0.25	48.05	0.03	1.00
ADJBLNEW	ADJBLNEW	22	2.00	0.70	34.70	0.72	3.11
ADJSECWT	ADJSECWT	6	0.29	0.15	52.53	0.14	0.47
ADJTOTFL	ADJTOTFLKG	6	1.97	0.83	42.02	0.86	3.30
AFD	AFD	22	28.38	5.67	19.96	21.60	39.60
SDFD	SDFD	22	5.80	1.25	21.51	4.10	9.00
CVFD	CVFD	22	20.49	1.47	7.16	18.10	23.30
LESS15	LESS15	22	0.61	0.94	153.56	0.00	3.80
CF	CF	22	66.21	29.89	45.14	9.60	96.00
ADJSLMM	ADJSLMM	22	126.89	18.83	14.84	78.28	160.44
CRV	CRV	22	10.76	1.79	16.67	7.30	14.20
AFDBIOP	AFDBIOP	14	29.86	5.87	19.65	20.10	41.40
SPRATIO	SPRATIO	21	7.44	2.11	28.40	4.60	12.20
FD	FD	21	28.54	12.57	44.06	11.60	63.00
SKINTHIC	SKINTHICK	14	2.26	0.37	16.44	1.70	2.92
GROWRAT	GROWRAT	9	0.39	0.05	13.57	0.31	0.46
FLSLRATI	FLSLRATI	13	0.95	0.02	1.84	0.92	0.98
PRIMAFD	PRIMAFD	14	38.26	5.24	13.70	31.40	49.50
PRIMSDFD	PRIMSDFD	14	5.74	0.95	16.57	4.20	8.20
PRIMCVFD	PRIMCVFD	14	15.15	2.23	14.70	10.80	18.90
PRIMMIN	PRIMMIN	14	26.21	5.24	19.97	16.00	33.00
PRIMMAX	PRIMMAX	14	53.21	5.98	11.23	40.00	64.00
PRIMMED	PRIMMED	12	99.83	0.58	0.58	98.00	100.00
SECAFD	SECAFD	14	28.74	5.81	20.23	19.10	39.90

SECSDFD	SECSDFD	14	4.24	0.66	15.57	3.10	5.70
SECCVFD	SECCVFD	14	15.08	1.85	12.24	11.90	18.20
SECMIN	SECMIN	14	18.93	5.76	30.42	10.00	30.00
SECMAX	SECMAX	14	41.50	8.55	20.59	27.00	54.00
SECMED	SECMED	12	67.50	34.12	50.55	9.00	100.00
ADJMFL	ADJMFL	13	143.17	23.46	16.39	111.75	187.39
ADJFLSD	ADJFLSD	13	6.48	2.97	45.83	3.01	11.45
FLCV	FLCV	13	4.50	1.75	38.84	1.90	7.80
ADJFLMIN	ADJFLMIN	13	126.91	22.49	17.72	95.90	165.57
ADJFLMAX	ADJFLMAX	13	153.64	25.55	16.63	121.34	205.70
SCTH	SCTH	5	396.50	79.13	19.96	306.30	517.00
SCL	SCL	7	12.15	1.85	15.20	10.77	16.09
RAWLUSSC	RAWLUSSC	22	1.68	0.48	28.35	1.00	2.00
CLLUSTSC	CLLUSTSC	22	1.95	0.58	29.44	1.00	3.00
DIFFINT	DIFFINT	14	818.14	891.40	108.95	17.00	2521.0
RRL	RRL	14	0.22	0.30	136.25	0.03	0.87

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---------- LOC=C ----------

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
LOCKCON	LOCKCON	22	5.55	1.18	21.36	3.00	8.00
BUN	BUN	22	20.91	4.01	19.18	14.00	33.00
BUN123	BUN123	22	2.05	0.21	10.42	2.00	3.00
CREATINI	CREATINI	22	1.60	0.36	22.49	1.00	2.40
CREAT123	CREAT123	22	2.18	0.39	18.09	2.00	3.00
GLUCOSE	GLUCOSE	22	115.23	36.02	31.26	9.00	186.00
GLUC123	GLUC123	22	2.05	0.49	23.75	1.00	3.00
TOTPROT	TOTPROT	22	6.65	0.50	7.53	5.20	7.60
TPROT123	TPROT123	22	2.32	0.48	20.56	2.00	3.00
ALBUMIN	ALBUMIN	22	6.17	8.90	144.33	3.30	46.00
ALBUM123	ALBUM123	22	1.95	0.21	10.91	1.00	2.00
TOTBILR	TOTBILR	16	0.10	0.00	0.00	0.10	0.10
BILRU123	BILRU123	22	2.00	0.00	0.00	2.00	2.00
CK	CK	22	239.91	382.43	159.41	32.00	1729.0
CK123	CK123	22	1.95	0.38	19.19	1.00	3.00
GGT	GGT	22	21.68	6.85	31.62	6.00	37.00
GGT123	GGT123	22	1.95	0.21	10.91	1.00	2.00
ASTSGOT	ASTSGOT	22	175.64	27.10	15.43	113.00	223.00
AST123	AST123	22	1.95	0.21	10.91	1.00	2.00
SOD	SOD	22	148.05	1.70	1.15	144.00	151.00
SOD123	SOD123	22	2.00	0.00	0.00	2.00	2.00
POT	POT	22	5.80	0.72	12.38	4.80	7.70
POT123	POT123	22	2.23	0.43	19.26	2.00	3.00
CL	CL	22	106.77	3.56	3.33	97.00	111.00
CL123	CL123	22	1.95	0.21	10.91	1.00	2.00
CAL	CAL	22	9.73	0.34	3.52	9.00	10.40
CAL123	CAL123	22	2.00	0.00	0.00	2.00	2.00
PHOS	PHOS	22	14.12	21.94	155.35	4.80	104.00
PHOS123	PHOS123	22	2.05	0.21	10.42	2.00	3.00
MG	MG	22	2.37	0.23	9.78	1.89	2.86
MG123	MG123	22	2.68	0.48	17.78	2.00	3.00
TCO2	TCO2	22	25.71	3.42	13.32	16.70	30.30
TCO2123	TCO2123	22	1.86	0.35	18.85	1.00	2.00
SDH	SDH	22	5.74	3.75	65.31	0.70	12.30
SDH123	SDH123	22	1.86	0.35	18.85	1.00	2.00
ANIONGAP	ANIONGAP	22	21.45	5.75	26.78	14.00	35.00
AG123	AG123	22	2.09	0.43	20.39	1.00	3.00
TOTWBC	TOTWBC	21	13757	6136.7	44.61	1000.0	25000
WBC123	WBC123	21	1.86	0.48	25.74	1.00	3.00
DIFNEUT	DIFNEUT	21	55.81	12.71	22.78	29.00	82.00
DIFNE123	DIFNE123	21	2.24	0.44	19.50	2.00	3.00
DIFBANDS	DIFBANDS	0	.	.	.	.	.
DIFB123	DIFB123	0	.	.	.	.	.
DIFMYEL	DIFMYEL	1	25.00	.	.	25.00	25.00
DIFLYMPH	DIFLYMPH	21	30.19	11.67	38.65	6.00	53.00

---------- LOC=C ----------

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
DIFLY123	DIFLY123	21	1.62	0.50	30.73	1.00	2.00
DIFMONO	DIFMONO	20	3.50	2.72	77.83	1.00	14.00
DIFMO123	DIFMO123	20	2.05	0.22	10.91	2.00	3.00
DIFEOSIN	DIFEOSIN	21	9.14	6.14	67.18	1.00	24.00
DIFEO123	DIFEO123	21	2.00	0.00	0.00	2.00	2.00
DIFBASO	DIFBASO	3	1.33	0.58	43.30	1.00	2.00
DIFBA123	DIFBA123	3	2.00	0.00	0.00	2.00	2.00
NEUT	NEUT	21	7565.0	3904.1	51.61	580.00	16750
NEUT123	NEUT123	21	1.86	0.48	25.74	1.00	3.00
BANDS	BANDS	4	302.00	125.39	41.52	153.00	459.00
BANDS123	BANDS123	3	3.00	0.00	0.00	3.00	3.00
LYMPHOCY	LYMPHOCY	21	4122.3	2638.1	64.00	320.00	10971
LYMPH123	LYMPH123	21	2.19	0.60	27.46	1.00	3.00
MONOCYTE	MONOCYTE	20	459.35	410.82	89.43	50.00	2002.0
MONO123	MONO123	20	2.05	0.22	10.91	2.00	3.00
EOSINPHI	EOSINPHI	21	1422.4	1190.8	83.72	36.00	4344.0
EOSIN123	EOSIN123	21	1.76	0.54	30.59	1.00	3.00
BASOPHIL	BASOPHIL	4	114.75	80.90	70.51	1.00	191.00
BASO123	BASO123	3	2.00	0.00	0.00	2.00	2.00
RBC	RBC	21	16.21	2.72	16.81	9.88	20.00
RBC123	RBC123	21	2.38	0.59	24.76	1.00	3.00
HEMOGLO	HEMOGLO	21	14.80	1.94	13.09	10.20	17.90
HGB123	HGB123	21	1.90	0.30	15.79	1.00	2.00
SPUNPCV	SPUNPCV	21	32.10	5.72	17.82	17.00	40.00
PCV123	PCV123	21	1.86	0.36	19.31	1.00	2.00
MCH	MCH	21	9.23	0.80	8.64	7.80	10.50
MCH123	MCH123	21	1.33	0.48	36.23	1.00	2.00
NUCRBC	NUCRBC	6	41.00	95.54	233.03	1.00	236.00
PLATELEC	PLATELEC	16	322.13	166.93	51.82	78.00	554.00
PLATE123	PLATE123	17	2.00	0.87	43.30	1.00	3.00
PLASPRO	PLASPRO	21	6.64	0.54	8.08	5.50	7.70
PPROT123	PPROT123	21	2.00	0.32	15.81	1.00	3.00
FIBRINOG	FIBRINOG	18	216.67	104.32	48.15	100.00	400.00
FIBRI123	FIBRI123	21	1.90	0.30	15.79	1.00	2.00
RBCMO123	RBCMO123	15	2.00	0.00	0.00	2.00	2.00
WBCMO123	WBCMO123	20	2.00	0.00	0.00	2.00	2.00
SE	SE	14	196.36	25.90	13.19	169.00	263.00
SE123	SE123	14	3.00	0.00	0.00	3.00	3.00
BORON	BORON	20	1.00	0.00	0.00	1.00	1.00
BORON123	BORON123	20	2.00	0.00	0.00	2.00	2.00
CA	CA	20	94.05	2.98	3.17	88.00	101.00
CA123	CA123	20	2.00	0.00	0.00	2.00	2.00
CR	CR	20	0.10	0.00	0.00	0.10	0.10
CR123	CR123	20	2.00	0.00	0.00	2.00	2.00
CU	CU	20	0.44	0.08	19.14	0.18	0.61

---------- LOC=C ----------

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
CU123	CU123	20	1.95	0.22	11.47	1.00	2.00
FE	FE	20	1.26	0.19	15.27	0.98	1.60
FE123	FE123	20	2.00	0.00	0.00	2.00	2.00
MAG	MAG	20	22.00	1.74	7.91	18.20	26.00
MAG123	MAG123	20	2.05	0.22	10.91	2.00	3.00
PS	PS	20	73.65	16.18	21.97	40.00	103.00

PS123	PS123	20	2.05	0.22	10.91	2.00	3.00
K	K	20	183.30	13.49	7.36	161.00	207.00
K123	K123	20	2.00	0.00	0.00	2.00	2.00
NA	NA	20	3408.0	44.79	1.31	3330.0	3490.0
NA123	NA123	20	2.00	0.00	0.00	2.00	2.00
ZN	ZN	20	0.27	0.10	38.08	0.14	0.63
ZN123	ZN123	20	1.85	0.49	26.45	1.00	3.00

Appendix Table 1 (continued). All traits, animals from East region only

---------- LOC=E ----------

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
AGE	AGE	10	2.52	0.44	17.49	1.92	2.98
BWKG	BWKG	10	72.30	10.04	13.89	52.16	86.18
HTCM	HTCM	10	90.55	2.68	2.96	86.36	93.98
BCS	BCS	10	5.20	0.42	8.11	5.00	6.00
ADJBLANK	ADJBLANK	10	1.59	0.36	22.77	1.19	2.15
ADJNECKW	ADJNECKW	10	0.70	0.25	35.39	0.34	1.16
ADJBLNEW	ADJBLNEW	10	2.30	0.59	25.49	1.58	3.22
ADJSECWT	ADJSECWT	0	.	.	.	.	.
ADJTOTFL	ADJTOTFLKG	0	.	.	.	.	.
AFD	AFD	10	24.79	2.95	11.90	21.00	30.80
SDFD	SDFD	10	5.52	1.13	20.42	4.30	7.30
CVFD	CVFD	10	22.10	2.31	10.45	18.70	26.20
LESS15	LESS15	10	1.08	1.18	109.10	0.00	3.60
CF	CF	10	84.48	12.82	15.17	55.40	96.10
ADJSLMM	ADJSLMM	10	130.14	16.19	12.44	99.73	149.59
CRV	CRV	10	10.99	1.64	14.95	7.80	12.80

AFDBIOP	AFDBIOP	10	24.64	2.52	10.23	21.30	30.20
SPRATIO	SPRATIO	10	7.38	1.66	22.54	3.20	9.10
FD	FD	10	27.84	4.32	15.53	22.70	37.00
SKINTHIC	SKINTHICK	10	2.51	0.33	13.18	2.14	3.13
GROWRAT	GROWRAT	10	0.41	0.05	12.57	0.31	0.46
FLSLRATI	FLSLRATI	10	0.94	0.03	3.73	0.87	0.98
PRIMAFD	PRIMAFD	10	38.25	6.77	17.71	29.60	53.60
PRIMSDFD	PRIMSDFD	10	5.96	2.38	39.88	3.40	10.40

---------- LOC=E ----------

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
PRIMCVFD	PRIMCVFD	10	15.21	3.72	24.45	9.80	20.00
PRIMMIN	PRIMMIN	10	27.00	2.75	10.18	22.00	32.00
PRIMMAX	PRIMMAX	10	52.70	11.40	21.64	37.00	78.00
PRIMMED	PRIMMED	6	100.00	0.00	0.00	100.00	100.00
SECAFD	SECAFD	10	23.15	2.10	9.09	19.10	27.20
SECSDFD	SECSDFD	9	4.39	1.63	37.03	3.40	8.50
SECCVFD	SECCVFD	10	18.79	4.97	26.45	14.20	31.30
SECMIN	SECMIN	10	13.90	2.96	21.30	8.00	18.00
SECMAX	SECMAX	10	36.50	9.87	27.04	30.00	64.00
SECMED	SECMED	6	50.33	22.65	45.00	22.00	74.00
ADJMFL	ADJMFL	10	148.21	17.52	11.82	115.48	168.54
ADJFLSD	ADJFLSD	10	10.89	8.97	82.40	3.79	31.11
FLCV	FLCV	10	7.33	5.65	77.09	2.40	18.50
ADJFLMIN	ADJFLMIN	10	118.48	28.18	23.78	65.82	149.59
ADJFLMAX	ADJFLMAX	10	156.47	23.18	14.81	114.69	189.48
SCTH	SCTH	4	450.00	117.33	26.07	297.00	542.00
SCL	SCL	7	13.46	1.70	12.60	11.08	15.50
RAWLUSSC	RAWLUSSC	0	.	.	.	.	.
CLLUSTSC	CLLUSTSC	0	.	.	.	.	.
DIFFINT	DIFFINT	7	599.86	1267.1	211.23	22.00	3448.0
RRL	RRL	7	0.37	0.24	65.57	0.03	0.68
LOCKCON	LOCKCON	0	.	.	.	.	.
BUN	BUN	10	16.10	5.09	31.60	11.00	26.00
BUN123	BUN123	10	2.00	0.00	0.00	2.00	2.00
CREATINI	CREATINI	10	1.80	0.29	15.93	1.50	2.30
CREAT123	CREAT123	10	2.60	0.52	19.86	2.00	3.00
GLUCOSE	GLUCOSE	10	161.40	33.63	20.84	116.00	207.00
GLUC123	GLUC123	10	2.70	0.48	17.89	2.00	3.00
TOTPROT	TOTPROT	10	6.45	0.33	5.13	6.00	6.80
TPROT123	TPROT123	10	2.00	0.00	0.00	2.00	2.00
ALBUMIN	ALBUMIN	10	4.11	0.35	8.54	3.50	4.70
ALBUM123	ALBUM123	10	2.00	0.00	0.00	2.00	2.00
TOTBILR	TOTBILR	8	0.10	0.00	0.00	0.10	0.10
BILRU123	BILRU123	10	2.00	0.00	0.00	2.00	2.00
CK	CK	10	135.90	69.73	51.31	58.00	269.00
CK123	CK123	10	2.00	0.00	0.00	2.00	2.00
GGT	GGT	10	14.80	5.85	39.50	6.00	25.00
GGT123	GGT123	10	1.90	0.32	16.64	1.00	2.00
ASTSGOT	ASTSGOT	10	198.40	44.18	22.27	128.00	265.00
AST123	AST123	10	2.00	0.00	0.00	2.00	2.00
SOD	SOD	10	148.30	2.36	1.59	144.00	151.00
SOD123	SOD123	10	2.00	0.00	0.00	2.00	2.00
POT	POT	10	4.94	0.83	16.78	4.00	7.00
POT123	POT123	10	2.00	0.00	0.00	2.00	2.00
CL	CL	10	109.10	2.47	2.26	105.00	114.00

---------- LOC=E ----------

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
CL123	CL123	10	2.00	0.00	0.00	2.00	2.00
CAL	CAL	10	9.80	0.40	4.11	9.20	10.30
CAL123	CAL123	10	2.00	0.00	0.00	2.00	2.00
PHOS	PHOS	10	7.03	1.69	24.03	5.20	9.90
PHOS123	PHOS123	10	2.00	0.00	0.00	2.00	2.00
MG	MG	10	2.25	0.18	8.16	1.90	2.49
MG123	MG123	10	2.50	0.53	21.08	2.00	3.00
TCO2	TCO2	10	23.47	2.55	10.88	20.50	26.40
TCO2123	TCO2123	10	1.60	0.52	32.27	1.00	2.00
SDH	SDH	10	6.56	2.86	43.57	3.10	11.00
SDH123	SDH123	10	2.00	0.00	0.00	2.00	2.00
ANIONGAP	ANIONGAP	10	20.70	4.16	20.12	15.00	28.00
AG123	AG123	10	2.10	0.32	15.06	2.00	3.00
TOTWBC	TOTWBC	10	14120	5586.8	39.57	7700.0	24700
WBC123	WBC123	10	2.00	0.47	23.57	1.00	3.00
DIFNEUT	DIFNEUT	10	48.80	9.21	18.88	32.00	66.00
DIFNE123	DIFNE123	10	2.10	0.32	15.06	2.00	3.00
DIFBANDS	DIFBANDS	1	1.00	.	.	1.00	1.00
DIFB123	DIFB123	1	3.00	.	.	3.00	3.00
DIFMYEL	DIFMYEL	0	.	.	.	.	.
DIFLYMPH	DIFLYMPH	10	37.40	12.72	34.01	12.00	59.00
DIFLY123	DIFLY123	10	1.80	0.42	23.42	1.00	2.00
DIFMONO	DIFMONO	10	3.40	2.07	60.75	1.00	7.00
DIFMO123	DIFMO123	10	2.20	0.42	19.17	2.00	3.00
DIFEOSIN	DIFEOSIN	10	10.10	5.76	57.06	4.00	21.00
DIFEO123	DIFEO123	10	2.00	0.00	0.00	2.00	2.00
DIFBASO	DIFBASO	1	1.00	.	.	1.00	1.00
DIFBA123	DIFBA123	1	2.00	.	.	2.00	2.00
NEUT	NEUT	10	6983.1	3823.7	54.76	3080.0	16302
NEUT123	NEUT123	10	1.80	0.63	35.14	1.00	3.00
BANDS	BANDS	1	102.00	.	.	102.00	102.00
BANDS123	BANDS123	1	2.00	.	.	2.00	2.00
LYMPHOCY	LYMPHOCY	10	5078.3	2720.4	53.57	2820.0	11977
LYMPH123	LYMPH123	10	2.50	0.53	21.08	2.00	3.00
MONOCYTE	MONOCYTE	10	418.10	247.36	59.16	188.00	1015.0
MONO123	MONO123	10	2.10	0.32	15.06	2.00	3.00
EOSINPHI	EOSINPHI	10	1582.4	1503.8	95.03	385.00	5187.0
EOSIN123	EOSIN123	10	1.90	0.57	29.88	1.00	3.00
BASOPHIL	BASOPHIL	2	124.00	42.43	34.21	94.00	154.00
BASO123	BASO123	2	2.00	0.00	0.00	2.00	2.00
RBC	RBC	10	15.86	2.37	14.97	12.29	18.69
RBC123	RBC123	10	2.30	0.48	21.00	2.00	3.00
HEMOGLO	HEMOGLO	10	14.74	1.70	11.52	12.40	17.70
HGB123	HGB123	10	2.00	0.00	0.00	2.00	2.00
SPUNPCV	SPUNPCV	10	33.10	4.53	13.69	26.00	40.00

---------- LOC=E ----------

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
PCV123	PCV123	10	1.90	0.32	16.64	1.00	2.00
MCH	MCH	10	9.35	0.69	7.33	8.30	10.30
MCH123	MCH123	10	1.50	0.53	35.14	1.00	2.00
NUCRBC	NUCRBC	6	2.17	1.60	73.94	1.00	5.00
PLATELEC	PLATELEC	2	370.50	150.61	40.65	264.00	477.00
PLATE123	PLATE123	3	2.33	0.58	24.74	2.00	3.00
PLASPRO	PLASPRO	10	6.54	0.36	5.50	6.10	7.10
PPROT123	PPROT123	10	2.00	0.00	0.00	2.00	2.00
FIBRINOG	FIBRINOG	10	270.00	141.81	52.52	100.00	500.00
FIBRI123	FIBRI123	10	2.00	0.00	0.00	2.00	2.00
RBCMO123	RBCMO123	5	2.00	0.00	0.00	2.00	2.00
WBCMO123	WBCMO123	10	2.00	0.00	0.00	2.00	2.00
SE	SE	10	180.90	25.45	14.07	149.00	233.00
SE123	SE123	10	2.80	0.42	15.06	2.00	3.00
BORON	BORON	10	1.00	0.00	0.00	1.00	1.00
BORON123	BORON123	10	2.00	0.00	0.00	2.00	2.00
CA	CA	10	93.30	4.11	4.41	88.00	99.00
CA123	CA123	10	2.00	0.00	0.00	2.00	2.00
CR	CR	10	0.10	0.00	0.00	0.10	0.10
CR123	CR123	10	2.00	0.00	0.00	2.00	2.00
CU	CU	10	0.47	0.13	26.90	0.16	0.60
CU123	CU123	10	2.00	0.00	0.00	2.00	2.00
FE	FE	10	1.34	0.34	25.30	0.81	1.77
FE123	FE123	10	2.00	0.00	0.00	2.00	2.00
MAG	MAG	10	22.17	1.90	8.58	18.60	24.50
MAG123	MAG123	10	2.00	0.00	0.00	2.00	2.00
PS	PS	10	69.90	16.43	23.51	51.00	101.00
PS123	PS123	10	2.10	0.32	15.06	2.00	3.00
K	K	10	178.70	11.72	6.56	166.00	205.00
K123	K123	10	2.00	0.00	0.00	2.00	2.00
NA	NA	10	3554.0	108.65	3.06	3380.0	3690.0
NA123	NA123	10	2.00	0.00	0.00	2.00	2.00
ZN	ZN	10	0.43	0.12	27.27	0.27	0.66
ZN123	ZN123	10	2.40	0.52	21.52	2.00	3.00

Appendix Table 1 (continued). All traits, animals from West region only

---------- LOC=W ----------

Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
AGE	AGE	31	2.22	0.37	16.55	1.70	2.94
BWKG	BWKG	31	75.92	12.26	16.15	53.62	105.23
HTCM	HTCM	31	90.15	3.90	4.33	82.55	99.06
BCS	BCS	31	6.35	0.83	13.04	5.00	8.00
ADJBLANK	ADJBLANK	29	1.38	0.41	29.97	0.78	2.29
ADJNECKW	ADJNECKW	29	0.65	0.18	27.27	0.37	1.13
ADJBLNEW	ADJBLNEW	29	2.03	0.49	24.10	1.31	3.01
ADJSECWT	ADJSECWT	29	0.70	0.43	61.50	0.05	1.60
ADJTOTFL	ADJTOTFLKG	29	2.77	0.75	27.09	1.59	4.12
AFD	AFD	31	24.87	2.93	11.78	19.70	31.50
SDFD	SDFD	31	5.16	0.84	16.35	3.90	7.90
CVFD	CVFD	31	20.70	2.21	10.69	16.50	25.50
LESS15	LESS15	31	1.14	1.58	138.73	0.00	7.60
CF	CF	31	84.23	12.10	14.36	49.20	98.20
ADJSLMM	ADJSLMM	31	144.51	19.45	13.46	95.26	179.93
CRV	CRV	31	11.82	1.76	14.92	8.60	16.90
AFDBIOP	AFDBIOP	31	26.55	3.83	14.41	19.60	33.90
SPRATIO	SPRATIO	30	7.91	1.81	22.93	5.60	12.50
FD	FD	31	29.46	6.71	22.77	18.30	47.60
SKINTHIC	SKINTHICK	31	2.45	0.43	17.71	1.85	3.76
GROWRAT	GROWRAT	21	0.42	0.07	15.49	0.30	0.56
FLSLRATI	FLSLRATI	31	0.93	0.06	6.03	0.77	0.98
PRIMAFD	PRIMAFD	31	37.40	5.44	14.55	28.10	50.10
PRIMSDFD	PRIMSDFD	31	5.78	1.82	31.41	2.60	11.10
PRIMCVFD	PRIMCVFD	31	15.53	4.38	28.20	8.50	28.80
PRIMMIN	PRIMMIN	31	26.65	3.83	14.36	20.00	35.00
PRIMMAX	PRIMMAX	31	53.29	8.57	16.09	36.00	74.00
PRIMMED	PRIMMED	31	99.81	1.08	1.08	94.00	100.00
SECAFD	SECAFD	31	25.21	3.71	14.72	18.60	32.20
SECSDFD	SECSDFD	31	3.92	0.83	21.28	2.80	5.90
SECCVFD	SECCVFD	31	15.73	2.82	17.94	11.30	22.90
SECMIN	SECMIN	31	15.90	2.91	18.32	10.00	22.00
SECMAX	SECMAX	31	34.81	5.35	15.37	28.00	46.00
SECMED	SECMED	31	58.29	32.97	56.56	1.00	100.00
ADJMFL	ADJMFL	31	154.75	23.24	15.02	98.63	205.56
ADJFLSD	ADJFLSD	31	9.89	9.06	91.62	2.36	36.21
FLCV	FLCV	31	7.06	6.63	93.90	1.30	24.90
ADJFLMIN	ADJFLMIN	31	129.01	31.72	24.59	49.21	174.30
ADJFLMAX	ADJFLMAX	31	171.02	26.57	15.53	103.55	233.86
SCTH	SCTH	11	439.19	83.46	19.00	328.50	608.00
SCL	SCL	15	13.52	1.85	13.71	11.05	18.06
RAWLUSSC	RAWLUSSC	28	1.68	0.55	32.64	1.00	3.00
CLLUSTSC	CLLUSTSC	28	2.00	0.72	36.00	1.00	3.00
DIFFINT	DIFFINT	12	1721.9	1357.0	78.81	144.00	3396.0
RRL	RRL	12	0.07	0.07	99.58	0.02	0.21

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Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
LOCKCON	LOCKCON	28	5.50	1.29	23.47	4.00	8.00
BUN	BUN	27	19.78	5.24	26.51	8.00	31.00
BUN123	BUN123	27	2.00	0.28	13.87	1.00	3.00
CREATINI	CREATINI	27	1.42	0.19	13.41	1.10	1.90
CREAT123	CREAT123	27	2.07	0.27	12.87	2.00	3.00
GLUCOSE	GLUCOSE	27	119.00	12.70	10.67	98.00	150.00
GLUC123	GLUC123	27	2.00	0.00	0.00	2.00	2.00
TOTPROT	TOTPROT	27	6.64	0.36	5.39	5.90	7.40
TPROT123	TPROT123	27	2.15	0.36	16.85	2.00	3.00
ALBUMIN	ALBUMIN	27	4.24	0.22	5.08	3.90	4.70
ALBUM123	ALBUM123	27	2.00	0.00	0.00	2.00	2.00
TOTBILR	TOTBILR	27	0.10	0.00	0.00	0.10	0.10
BILRU123	BILRU123	27	2.00	0.00	0.00	2.00	2.00
CK	CK	27	119.26	96.85	81.21	54.00	446.00
CK123	CK123	27	2.00	0.00	0.00	2.00	2.00
GGT	GGT	27	20.37	6.88	33.77	11.00	41.00
GGT123	GGT123	27	2.04	0.19	9.45	2.00	3.00
ASTSGOT	ASTSGOT	27	209.41	96.13	45.91	119.00	592.00
AST123	AST123	27	2.04	0.34	16.57	1.00	3.00
SOD	SOD	27	150.59	3.05	2.03	146.00	158.00
SOD123	SOD123	27	2.04	0.19	9.45	2.00	3.00
POT	POT	27	5.15	0.91	17.58	4.20	8.50
POT123	POT123	27	2.04	0.19	9.45	2.00	3.00
CL	CL	27	109.15	2.05	1.88	104.00	113.00
CL123	CL123	27	2.00	0.00	0.00	2.00	2.00
CAL	CAL	27	10.04	0.45	4.49	8.80	11.10
CAL123	CAL123	27	2.15	0.36	16.85	2.00	3.00
PHOS	PHOS	27	6.79	1.28	18.88	5.10	11.20
PHOS123	PHOS123	27	2.00	0.00	0.00	2.00	2.00
MG	MG	27	2.26	0.17	7.54	1.96	2.57
MG123	MG123	27	2.52	0.51	20.22	2.00	3.00
TCO2	TCO2	27	29.10	2.43	8.34	23.20	32.70
TCO2123	TCO2123	27	2.07	0.27	12.87	2.00	3.00
SDH	SDH	27	5.43	6.09	112.22	2.30	35.10
SDH123	SDH123	27	2.04	0.19	9.45	2.00	3.00
ANIONGAP	ANIONGAP	27	17.48	2.31	13.21	14.00	24.00
AG123	AG123	27	1.96	0.19	9.80	1.00	2.00
TOTWBC	TOTWBC	27	17178	3602.8	20.97	10900	25100
WBC123	WBC123	27	2.11	0.32	15.17	2.00	3.00
DIFNEUT	DIFNEUT	27	52.26	12.10	23.16	25.00	72.00
DIFNE123	DIFNE123	27	2.26	0.45	19.77	2.00	3.00
DIFBANDS	DIFBANDS	3	1.00	0.00	0.00	1.00	1.00
DIFB123	DIFB123	3	3.00	0.00	0.00	3.00	3.00
DIFMYEL	DIFMYEL	3	2.00	0.00	0.00	2.00	2.00
DIFLYMPH	DIFLYMPH	26	35.00	12.89	36.82	12.00	67.00

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Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
DIFLY123	DIFLY123	26	1.69	0.47	27.81	1.00	2.00
DIFMONO	DIFMONO	21	3.29	2.65	80.60	0.00	12.00
DIFMO123	DIFMO123	21	2.05	0.22	10.66	2.00	3.00
DIFEOSIN	DIFEOSIN	26	8.50	6.54	76.98	1.00	30.00
DIFEO123	DIFEO123	26	2.00	0.00	0.00	2.00	2.00
DIFBASO	DIFBASO	5	3.40	4.28	125.82	1.00	11.00
DIFBA123	DIFBA123	5	2.20	0.45	20.33	2.00	3.00
NEUT	NEUT	27	8813.7	2199.4	24.95	4773.0	12420
NEUT123	NEUT123	27	2.00	0.00	0.00	2.00	2.00
BANDS	BANDS	9	203.89	91.17	44.71	109.00	340.00
BANDS123	BANDS123	9	2.67	0.50	18.75	2.00	3.00
LYMPHOCY	LYMPHOCY	27	6051.0	3192.0	52.75	38.00	14941
LYMPH123	LYMPH123	27	2.52	0.58	23.02	1.00	3.00
MONOCYTE	MONOCYTE	21	566.81	455.90	80.43	0.00	2112.0
MONO123	MONO123	21	2.10	0.30	14.36	2.00	3.00
EOSINPHI	EOSINPHI	26	1552.9	1393.1	89.71	109.00	6120.0
EOSIN123	EOSIN123	26	1.85	0.46	25.14	1.00	3.00
BASOPHIL	BASOPHIL	5	528.00	671.23	127.13	190.00	1727.0
BASO123	BASO123	5	2.20	0.45	20.33	2.00	3.00
RBC	RBC	27	14.67	2.08	14.16	11.18	18.56
RBC123	RBC123	27	2.11	0.32	15.17	2.00	3.00
HEMOGLO	HEMOGLO	27	14.40	1.59	11.07	11.30	17.50
HGB123	HGB123	27	1.93	0.27	13.86	1.00	2.00
SPUNPCV	SPUNPCV	27	30.54	4.13	13.51	24.00	38.00
PCV123	PCV123	27	1.81	0.40	21.81	1.00	2.00
MCH	MCH	27	9.88	0.78	7.93	8.30	11.50
MCH123	MCH123	27	1.78	0.42	23.83	1.00	2.00
NUCRBC	NUCRBC	7	2.57	2.44	94.88	1.00	8.00
PLATELEC	PLATELEC	10	218.60	132.47	60.60	72.00	458.00
PLATE123	PLATE123	22	1.73	0.55	31.87	1.00	3.00
PLASPRO	PLASPRO	27	6.71	0.38	5.72	6.00	7.50
PPROT123	PPROT123	27	2.04	0.19	9.45	2.00	3.00
FIBRINOG	FIBRINOG	27	248.15	105.14	42.37	100.00	400.00
FIBRI123	FIBRI123	27	2.00	0.00	0.00	2.00	2.00
RBCMO123	RBCMO123	15	2.00	0.00	0.00	2.00	2.00
WBCMO123	WBCMO123	27	2.00	0.00	0.00	2.00	2.00
SE	SE	31	153.65	37.24	24.24	83.00	251.00
SE123	SE123	31	2.16	0.73	33.99	1.00	3.00
BORON	BORON	31	1.00	0.00	0.00	1.00	1.00
BORON123	BORON123	31	2.00	0.00	0.00	2.00	2.00
CA	CA	31	95.84	3.63	3.79	88.00	106.00
CA123	CA123	31	2.03	0.18	8.84	2.00	3.00
CR	CR	31	0.10	0.00	0.00	0.10	0.10
CR123	CR123	31	2.00	0.00	0.00	2.00	2.00
CU	CU	31	0.47	0.08	16.56	0.32	0.68

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Variable	Label	N	Mean	Std Dev	Coeff of Variation	Min	Max
CU123	CU123	31	2.00	0.00	0.00	2.00	2.00
FE	FE	31	1.29	0.24	18.99	0.83	1.80
FE123	FE123	31	2.00	0.00	0.00	2.00	2.00
MAG	MAG	31	22.48	1.94	8.63	19.40	27.10
MAG123	MAG123	31	2.03	0.18	8.84	2.00	3.00
PS	PS	31	67.52	13.13	19.44	48.00	112.00
PS123	PS123	31	2.03	0.18	8.84	2.00	3.00

K	K	31	202.00	32.86	16.27	163.00	325.00
K123	K123	31	2.03	0.18	8.84	2.00	3.00
NA	NA	31	3518.7	88.91	2.53	3350.0	3710.0
NA123	NA123	31	2.00	0.00	0.00	2.00	2.00
ZN	ZN	31	0.22	0.08	35.05	0.10	0.53
ZN123	ZN123	31	1.58	0.56	35.69	1.00	3.00

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