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REPRODUCTIVE POTENTIAL OF SITKA BLACK-TAILED DEER IN SOUTHEAST ALASKA

By

Loyal J. Johnson

Final Report
Federal Aid in Wildlife Restoration
Project W-22-4 and W-22-5, Job 2.8R

September 1987

MEMORANDUM State of Alaska

TO: Doug Larsen
Game Biologist II
Division of Game
Kotzebue

THRU:

DATE: January 20, 1988

FILE NO.:

TELEPHONE NO.: 465-4265

SUBJECT: Participation in Unit 4 Deer Research

FROM: Dave Anderson
Regional Supervisor
Division of Game
Douglas

Loyal Johnson recently called my attention to the fact that he inadvertently failed to acknowledge your contribution to the deer research project in Unit 4 (Reproductive potential of Sitka black-tailed deer in Southeast Alaska, Project W-22-4 and W-22-5, Job 2.8R). Loyal regrets this omission and informs me that a complete acknowledgment would include the following:

> Doug Larsen, ADF&G Technician for the field phase of this project, made invaluable contributions in field operations, specimen and data preparation, and equipment management.

Because the error was undetected prior to submission of the final draft, and because the editor does not exercise control over the acknowledgment of staff, your contribution was not mentioned in the final report. Rest assured, however, that your efforts have not gone unnoticed.

cc: Lew Pamplin
Steve Peterson
Regional Supervisors
Loyal Johnson, Sitka

Sid:
Please attach to
our file copy
SPP
21 Jan 88

FINAL REPORT (RESEARCH)

State: Alaska

Cooperators: None

Project No.: W-22-4 W-22-5 Project Title: Wildlife Research and Management

Study No.: 2.8R Study Title: Reproductive Potential of Sitka Black-Tailed Deer in Southeast Alaska

Period Covered: 1 July 1984-30 June 1986

SUMMARY

Sitka black-tailed deer collected during February 1985 in Hoonah Sound and specimens obtained from hunters during the 1985 season provided 100 sets of jaws and ovaries for analysis. Precise age determinations were accomplished through tooth sectioning, and the data set ranged from fawns through deer 15 years of age. Ovarian analyses provided counts of *corpora lutea* of pregnancy and of *corpora albicantia*. *In utero* examination of specimens provided fetal counts and pregnancy determination. These analyses indicate that Sitka black-tailed deer do not breed as fawns, about 60% breed as yearlings, does ages 2 through 10-12 breed annually, and reproductive senescence begins at about age 10-12 when pregnancy rates and productivity fall off rapidly. Yearling does produce an average of about 1.2 fawns per year, does age 2-4 produce about 1.8 fawns per year, and does ages 5-10 produce about 2.0 fawns per year. Does beyond ages 10-12 produce less than 1.0 fawn per year and by age 15, which is probably the maximum life span for Sitka black-tailed deer, reproduction has essentially ceased.

Fetal measurements and development of *corpora lutea* of pregnancy show that conception did not occur prior to November 22 in does over 4 years of age. Hunter-killed does 3 years of age and under had not conceived by December 31. Peak breeding in multiparous does occurs about November 24.

Parasitological examination showed Sitka black-tailed deer to be relatively free of pathogenic parasites with 1 significant exception: all fawns examined harbored what appeared to be

fatal infestations of lungworm. This may account for the low number of yearling does in the collection. All deer examined harbored an apparently benign nematode in the abomasum.

Rumen contents were composed of the following items, by percent volume: conifer foliage, 47; half shrubs, 26; grass/sedge, 8; kelp, 7; lichens, 4; shrubs, 3; moss/ferns, 3; and forbs, <1.

Body weights and measurements, kidney fat indices, and blood chemistry are included as reference material.

Key Words: Corpora albicantia, corpora lutea, fertility, in utero, Odocoileus hemionus sitkensis, parasites, pregnancy rates, reproductive potential, rumen contents.

CONTENTS

BACKGROUND

The range of Sitka black-tailed deer (Odocoileus hemionus sitkensis [SBT]) includes the dense coastal forests of northern British Columbia, islands of southeastern Alaska (the Alexander Archipelago), and a narrow strip of forested habitat along the adjacent mainland. Transplants have extended the natural distribution northward to Yakutat, Prince William Sound, and westward to the Kodiak Island group (Elkins and Nelson 1954).

SBT are the most important big game species in southeastern Alaska, with an annual estimated harvest of up to 15,000 animals (Alaska Department of Fish and Game [ADF&G] records). Additionally, SBT are used in a nonconsumptive way by people who enjoy viewing and photographing them.

Few quantitative physiological data are available for this species; this lack precludes establishment of sound management goals and objectives. For instance, lack of knowledge of reproductive potential makes it impossible to assess and predict the ability of deer populations to rebound following

periodic winter die-offs (Merriam 1970). Game managers are also unable to develop management goals that would allow manipulation of populations through hunter harvests because reproductive capabilities and subsequent annual increments are unknown.

Additionally, biologists and land-use planners have had difficulties predicting the quantitative effects of habitat alterations on deer. These alterations include the extensive harvesting of old-growth timber in southeastern Alaska. Recent research (see below) demonstrates that deer numbers decline as the carrying capacity of their range is reduced by large-scale cutting of old-growth forest.

Past research has focused on habitat-use patterns of SBT (Klein 1965; Bloom 1978; Schoen 1978; Barrett 1979; Billings and Wheeler 1979; Schoen and Wallmo 1979; Schoen et al. 1979; Wallmo and Schoen 1980; Rose 1982; Schoen and Kirchhoff 1982, 1985). Results show that the deer of southeastern Alaska are dependent upon uneven-aged, old-growth forests. Logged, second-growth habitat maintains substantially fewer deer than old growth.

While the studies cited above have been valuable for understanding the habitat requirements of deer in southeastern Alaska, objective and effective management requires additional information relating to the health, condition, and productivity of the deer population. Merriam (1960, and subsequent Federal Aid reports) looked at habitat requirements of SBT and proposed to examine the reproductive biology of the species (under Federal Aid in Wildlife Restoration, Project W-6-R-3, 1963), but the results of that study apparently were not published. Klein (1963, 1964, 1965) correlated range condition with body size for SBT on 2 small islands in southeastern Alaska but offered no information pertaining to reproductive biology. Schoen et al. (1982) examined the reproductive tracts of 6 female deer collected in spring 1981 for diet, reproduction, and condition studies, and noted *in utero* (IU) counts of 1.8 fawns per adult doe. No ovarian analyses were reported.

The reproductive biology of most mammals in North America is well understood and documented (see Chapman and Feldhamer 1982). Taber (1953), Golley (1957), Kistner et al. (1980), and Thomas (1970, 1983) have published important information on reproductive studies for the Columbian black-tailed deer (*O. hemionus columbianus* [CBT]). However, an extensive review of the literature revealed only the limited and cursory data of Schoen et al. (1982) pertaining to the SBT subspecies.

Deer management in Alaska has been successful simply because the undisturbed habitat has produced an abundance of deer. Predictable severe winter weather cycles (Juday 1984) have caused natural fluctuations in deer numbers (see also Merriam 1970). Typically, populations have rebounded when winter severity moderated. However, clear-cut logging of approximately 20,000 acres per year is causing massive alteration of productive wildlife habitat. Logged areas managed under 90- to 120- year rotations will never again support deer densities comparable to those found in unaltered habitat. Managers now need a better understanding of the physiological responses of deer to natural and altered habitat conditions since human populations and demands are increasing while the habitat base is shrinking.

OBJECTIVES

To determine the reproductive potential of SBT in southeastern Alaska; specifically:

1. To determine age-specific ovulation and fertilization rates.

2. To determine the importance of each of 4 age classes to population productivity.

3. To determine the age of 1st breeding and the age at which fertility begins to decline (reproductive senescence).

STUDY AREA

SBT were collected from the Hoonah Sound area of Baranof and Chichagof Islands in southeastern Alaska (Fig. 1). This area was selected because of its high deer population, its remoteness from high human-use areas, and because the habitat there is relatively pristine. Additional specimens were obtained from hunter-killed animals taken in the area outlined in Fig. 1.

MATERIALS AND METHODS

Traditionally, deer have been aged by the tooth replacement and wear technique described by Severinghaus (1949). More recently, tooth sectioning has replaced the Severinghaus technique because sectioning provides more precise results (Thomas and Bandy 1973).

The breeding history of individual female deer can be determined through ovarian analyses (Thomas 1970, 1983). Information from such analyses, when correlated with different age classes of a population, can be used to determine the reproductive potential of the population.

Limited attempts were made to obtain reproductive materials from hunter-killed animals in fall 1984. Failure to obtain a sufficient sample in this way required the collection of additional samples after the deer season ended.

Deer were collected from the study area during February 1985 when deep snow caused deer to concentrate at low elevations. They were collected by approaching from salt water in skiffs and shooting at close range to produce instant death. Each deer was immediately weighed whole and the sternum split, allowing access to the anterior vena cava, from which blood samples were collected. Blood samples were collected in 3-cc Vacutainers (Vacutainer Systems, Rutherford, N.J.). Two red-stoppered and 1 each purple-, green-, and gray-stoppered Vacutainers were filled, when possible, from each animal. The red-stoppered Vacutainers contained no additives and were used to collect whole blood. Purple-, green-, and gray-stoppered Vacutainers contained the anticoagulants Ethylenediaminotetra-acetate (EDTA), Heparin, and Sodium-fluoride, respectively, and were used to measure packed cell volume (PCV), electrolytes, and glucose levels, respectively. After blood samples were collected, the specimens were taken to the field camp where the following measurements were taken: total length, tail length, right hind foot, head length, head width, and chest girth. Deer were then eviscerated and the following specimens collected, labeled, and stored: complete reproductive tract, mandible, heart, liver, hair sample, rump muscle tissue, left femur, left kidney with fat naturally attached, rumen sample, and fecal sample. Eviscerated carcasses were weighed and examined carefully for ectoparasites. The lungs, (caeca), and small intestines were opened and examined for internal parasites. Subcutaneous fat was measured at its thickest place along the spine, approximately 10-cm anterior to the base of the tail. Skinned carcasses, with feet removed at tarsal and carpal joints and head removed at atlantal-occipital articulation, were weighed. Finally, all edible flesh was removed and stored for later delivery to the Alaska Pioneers Home in Sitka. During this process, careful observations were made for tapeworm cysticerci.

The whole blood was centrifuged and sera extracted and frozen. Blood samples containing anticoagulants were refrigerated. Organs were weighed on an Ohaus 2610 triple beam balance (Ohaus, Florham Park, N.J.) as follows: Hearts were trimmed to remove extraneous tissue, split longitudinally, rinsed to remove all blood from the auricles and ventricles, and

weighed. Livers were rinsed and all extraneous tissue (congealed blood, diaphragm, kidney, blood vessels) was removed prior to weighing. The left kidney from each animal was weighed with and without adhering fat deposits. Kidney fat was cut from both ends of the kidney, perpendicular to the long axis (Kirkpatrick 1980). Fat was also cut from the convex (top) side of each kidney. After weight with fat had been obtained, the remaining fat was peeled off and the kidney reweighed. The kidney fat index (KFI) was calculated by dividing the fresh weight of the kidney fat by the fresh weight of the fat-free kidney from each deer and multiplying by 100 (Finger et al. 1981). Ovaries were extracted and placed in 10% formalin. Mandible and femur bones were cleaned of extraneous tissue and frozen. Muscle samples approximately 10 cm^3 were taken from the biceps femoris of each deer and frozen. Rumen contents were mixed within each rumen, a sample taken, and stored in 10% formalin. Fetuses were sexed, weighed, and measured (forehead-rump length and left hind foot length [HFL].

During fall 1985, reproductive tracts and corresponding lower jaws were obtained from sport/subsistence hunters. These were labeled, ovaries/reproductive tracts preserved in 10% formalin, the 1st incisor (I_1) teeth removed from the mandible by boiling, then placed in paper envelopes, and all specimens stored for later shipment for analyses.

Ovarian analyses were performed by Dr. Terry Spraker (Wildlife Laboratories International, 1322 Webster Avenue, Fort Collins, Colorado 80525), following Thomas (1970, 1983). Ages were determined through sectioning of incisor teeth (I_1 when present) by Matson's (P.O. Box 308, Milltown, Montana 59851).

Rumen samples were analyzed by the Wildlife Habitat Management Laboratory, Washington State University (Pullman, Washington 99164) (Davitt and Nelson 1986).

Femur samples were analyzed for marrow fat content at the ADF&G lab in Anchorage following the dry-weight process (Neiland 1970).

Blood chemistry analyses (Multi-24) were conducted by Medical Laboratories Network (1899 Palma Drive, Ventura, California 93002). Packed cell volume (PCV) and hemoglobin (HGB) were determined at Sitka Community Hospital (209 Moller Street, Sitka, Alaska 99835).

Muscle, heart, liver, and kidney tissue samples are in storage at -62C at the University of Alaska, Fairbanks. Hair and fecal samples have not been analyzed but are stored in Sitka.

RESULTS AND DISCUSSION

General Results

From 16-26 February, 1985, 62 deer consisting of 54 does and 8 bucks were collected. No deer were crippled and lost. We found it easy to distinguish adult bucks from adult does based on the low angle at which bucks hold their ears and on facial color patterns; bucks had noticeably whiter faces than does. Antler pedicels could frequently be observed. The sex of fawns could not be determined without having the animal in hand. As a result, 6 of 13 fawns collected were bucks. Two yearling bucks were mistakenly shot for does.

The original intent was to collect 25 female deer each from fawn, yearling, 2-1/2- and 3-1/2+-year-old age classes. This was an unrealistic objective because of the impossibility of selecting known-age animals. In addition, the number of old does (up to 15 years) collected indicated the original objective was inappropriate for measuring overall herd productivity.

The low number of yearling-age-class animals collected (3) made it desirable to examine a larger sample of that age class because the age of 1st breeding and the magnitude of that 1st effort is an extremely important variable in population dynamics. Forty-eight jaw/ovary sets were obtained from hunters during the fall 1985 season. Seven of these were then 2-year-old animals, providing a more representative sample of does that were yearlings during the 1984 breeding season.

Examination of the 7 doe-fawn reproductive tracts revealed no fetuses. Therefore, we concluded early in our collecting efforts that this sample size would be sufficient and the likelihood of killing additional buck fawns could be eliminated, so no additional fawns were collected.

Specific Results

Objective 1. To determine age-specific ovulation and fertilization rates.

Determination of ovulation rates could not be accomplished outside of a controlled laboratory situation with live animals, which was beyond the scope of this study.

Age-specific fertilization rates are best represented by corpora lutea (CL) counts. IU fetal counts, which most accurately project actual productivity, do not precisely reflect fertilization rates because of early pregnancy fetal mortality. CL counts are also subject to misinterpretation in

calculating fertilization rates, primarily due to the development of secondary accessory CL (see "Discussion" below). However, it is often possible to differentiate between CL of pregnancy and accessory CL. When identified, accessory CL were excluded from CL counts (T. Spraker, pers. commun.). These are shown in Fig. 2 and Table 1. These data showed that successful ovulation, i.e., ovulation which results in pregnancy, did not occur in fawns during their 1st breeding season and yearling does produced 1.33 successful ova. From ages 2 to 12, two successful ova were produced annually. The ovulation rate declined sharply after age 12.

Objective 2. To determine the importance of each of 4 age classes to population productivity.

The original study plan sought to examine 25 female deer from the 4 age classes (fawn, yearling, 2-year and 3-year+). It was impractical to attempt to meet that objective because of the impossibility of selecting specific-age animals to collect. The age structure of deer collected (0.5-15 years) further demonstrated that such an objective was inadequate to measure the reproductive potential of a population of SBT. That objective was developed on the erroneous assumption that the life-span of the SBT is much shorter than it is now known to be.

The contribution of a particular age class of female deer can be determined only through ovarian analyses and/or IU fetal counts. Cumulative CL counts, cumulative fetal counts, and total corpora albicantia (CA) counts are presented in Fig. 2 and Table 1.

Cumulative CL and IU fetal count data represents the total possible number of CL and fetuses for does 0.5-15 years of age. These counts were computed by adding the mean CL or IU fetus counts for succeeding age classes to the previous year age class, beginning at age 1. CL and total CA counts were developed by Dr. Terry Spraker. Total CA counts were determined by counting CA scars on 50-micron-thick serial sections of each ovary. CA counts from the collection materials and from the hunter-killed sample were compared. No statistically significant difference was demonstrated ($P>0.05$), so the 2 sets of data were combined.

Based on cumulative CL counts, these data suggest that by age 15, a doe SBT would have produced about 28-30 fawns. IU fetal count data indicate that the same 15-year-old doe would have produced about 20-22 fawns. Total CA counts show the average 15-year-old doe to have produced about 12 fawns.

These discrepancies are discussed below.

Age-Specific Productivity

Average fetal counts by age class of doe are given in Table 1 and in Fig. 3. These data translate to a potential at-birth productivity of 139 fawns per 100 adult does. It is not known if the age structure of the population was adequately sampled in the collection. Ages of the does indicate that it was not for medium-age does; 2- to 7- year age classes are not adequately represented as we would intuitively suspect. If this assumption is true and the prime-breeding-age animals were underrepresented, then a fawn:doe ratio of 139:100 underestimates the reproductive potential of the population we sampled.

A fawn:doe ratio of 139:100 compares very favorably with the published reports for the CBT as summarized by Anderson (1981). Those sources report fawn:doe ratios of 124-149:100 with a mean of 136:100. Interestingly, Anderson's summarization shows mule deer to have a significantly higher reproductive potential than the black-tailed race. Reported mule deer fawn:doe ratios ranged from 119-185:100 with a mean of 150.

Objective 3. To determine the age of 1st breeding and the age at which fertility begins to decline (reproductive senescence).

The deer collected in Hoonah Sound during February 1985 provided a good basis for determining the age of 1st breeding and reproductive senescence, because age classes 0.5 through 15 years were represented. This material was supplemented by hunter-killed specimens taken during fall 1985.

Seven fawns, that is, animals approximately 10 months old at the time of collection, showed no instances of having bred the previous fall breeding season--at which time they would have been about 6 months old. Ovarian analysis was conducted on an additional 8 does, shot by hunters during fall 1985, that were in the 1-year age class. None contained CA of 5 months, which indicates they had not bred as fawns. These data suggest female SBT do not regularly breed during their 1st year.

Three yearling does were collected, and of these, two were pregnant. An additional 7 2-year-old does were collected from hunter kills in fall 1985. Four of these contained CA of 5 months. Apparently, SBT begin actively breeding during their 2nd year of life when about 60% of that age class will breed.

Reproductive senescence can be evaluated only on the does collected during February 1985 because no old-age animals were obtained from hunters. Hunter samples and the original collection showed that SBT does ages 3 through 10 breed

annually. For unknown reasons, 7-year-old does in the collection showed a reduced effort, which is thought to be merely a sampling artifact. At age 10, fetal counts began to decline sharply and by age 15 only 1 of 4 does carried fetuses, though that doe carried twins. It is assumed that 15 years represents about the maximum life span for SBT and that most are reproductively senescent at that time.

Analysis of ovarian bodies and scars and IU fetal counts to reconstruct reproductive histories of individual animals has been widely utilized. It is necessary to understand the relationship that exists between IU fetal, CL, and CA counts. These relationships are well discussed by Thomas (1970) based on extensive ovarian analysis on CBT. In general, well-defined 8-9 day follicular cycles occur beginning in November. These cycles continue until pregnancy results. Small (45 mm^3), short-lived CL develop from these cycles. Accessory CL may develop in large or small unruptured follicles or in small ruptured follicles. Additionally, follicles may rupture and develop into accessory CL at any time of year. These are a potential source of error in the interpretation of ovarian functions. CL of pregnancy grow rapidly to 100 mm^3 within 5-8 days. Those develop into distinctive scars that persist (as CA) for the life of the doe. Accessory CL probably become indistinct with time. However, ovarian analysis shortly after conception can be confusing because it is not always possible to differentiate between true CL of pregnancy and sympathetic or accessory CL. Consequently, CL counts are generally higher than IU fetal counts. Loss of fetuses through abortion or resorption can also result in CL counts being greater than fetal counts (Thomas 1970, Zwank 1979). In ovarian analyses, 3 bodies are distinct and can be differentiated from each other. These are: CL, CA of 5 months, and CA of 17 months and older.

Thomas (1970) reported a strong correlation between age and probable pregnancy rates based on CA counts. We found a poor correlation between CA counts and cumulative CL and/or fetal counts. This correlation decreased as the age of does increased. Thomas' sample did not contain as high a percentage of old-age animals as ours. Our data do show a reasonably good correlation between CL and fetal counts with CA counts through about age 8, though not the linear relationship Thomas reported. There are 2 possible explanations for this discrepancy in our data. CA's may become less distinct with age and not readily detectable histologically in SBT. That there is no increase in CA numbers beyond about age 10 tentatively supports this conclusion. It is also possible that the technique used in this study was not adequately sensitive to detect all CA, particularly in older-age animals.

Because of this very poor correlation, CA counts cannot be recommended for assessing population productivity in the SBT until the reason for these discrepancies is more fully understood.

In addition to the data collected that was specific to the study's objectives, we gathered some related information that has been useful in interpretation of results. These ancillary data are briefly presented below.

ANCILLARY FINDINGS

Conception

The precise time period when conception occurs in SBT is unknown. Hunters report that rutting behavior is most pronounced from late October through early December. These observations are frequently based on bucks' lack of wariness and responsiveness of both sexes to artificial calls.

Actual conception dates can be determined by 2 methods; fetal growth curves and ovarian examination. Thomas (1970) and Salwasser and Holl (1979) reported the HFL to be the most useful measurement for aging CBT and mule deer fetuses. Armstrong (1950) and Hudson and Browman (1959) provided fetal measurements for WT and mule deer fetuses from New York and Montana, respectively. These show that HFL--the measurement from the tip of the hoof to the angle of hock or tubercle of the tibio-fibula--to be about 61 mm for fetuses 83-85 days after conception. Thomas' (1970) data show the HFL of a fetal CBT to be about 55 mm at about 90 days after conception. Unfortunately, there are no published fetal growth curves for SBT.

HFL for fetuses taken in the February collection averaged 55.5 mm with no significant difference between males and females ($t = 0.43$, d.f. = 70, $P>0.1$). Since CBT and SBT are of comparable size, and if we assume fetuses of both species to show similar growth and development, fetal HFL of 55.5 mm suggests a gestation age of about 90 days, with peak conception occurring about 22 November.

Specimens of hunter-killed animals taken late in the hunting season can also provide an estimate of the peak conception period. Thomas (1970) observed in CBT in British Columbia that CL of pregnancy reach 100 mm^3 within 5-8 days of conception and are thus readily visible histologically.

Examination of reproductive materials collected from hunters during the 1985 hunting season are shown in Fig. 4. CL were not found in any does taken prior to 22 November, and all

adult does examined taken between then and 1 December 1985 had CL, which we assumed to be CL of pregnancy. The 1985 material shows that mean date of conception was about 22 November +/- 5 to 8 days, about the same as in 1984. Thomas (1970) reported consistency within 3-4 days of mean conception dates over the 6 years of his study.

I considered does to be pregnant if CL were found in the ovarian examination. In this study, the does had so recently conceived that no fetal membranes were detected in gross examination of reproductive tracts.

Thomas (1970) determined the mean gestation period for CBT to be about 203 days. Other than casual observations, time of parturition in the SBT is not documented, but presumably the gestation period is the same as that of CBT. If so, the data presented here are consistent with peak parturition occurring in early-to mid-June.

Fetal Mortality

The rate or amount of fetal mortality in early pregnancy is an important measurement if productivity is to be quantified through ovarian analysis, i.e., CL counts. Fetal mortality can be estimated through a comparison of CL with IU fetal counts. These data (Fig. 5) show that fetal mortality is a function of maternal age; it is relatively low (less than 5%) until about age 10. In does older than 10 years, early-pregnancy fetal mortality is about 20-25%. Zwank (1979) reported that fetal mortality between mid-pregnancy and parturition is greater than prior to mid-pregnancy in mule deer. If this is true for SBT, the error in relating CL counts to actual production is greater than that shown in Fig. 5.

Chronology of Breeding

Thomas (1970) observed that young female CBT's conceive at a later date than do older females. That observation can be made from the hunter- killed specimens in 1985. (See Fig. 4.) All does age 4 and older were pregnant after 22 November, whereas none of the does 3 and under were pregnant by 31 December, the end of the hunting season, after which no additional specimen materials were available. A similar analysis was conducted on materials from the February collection. This analysis was based on a comparison of fetal HFL with age of dam (Fig. 6). The smallest individual fetus as well as the lowest mean HFL were in age 1 and 2 dams, showing their peak conception date to be later than for middle-age does. These limited data also show smaller fetus size in older does.

Peak of Conception

Thomas (1970) reported that most adult doe CBT's conceive during a relatively short period. Fetal growth is rapid; at about 80 days after conception, HFL growth in white-tailed deer (O. virginianus [WTD]) and mule deer is about 2 mm per day (calculated from data presented by Armstrong [1950] and Hudson and Browman [1959]).

The median HFL of fetuses in the collection was 55.5 mm. If SBT exhibit HFL growth rates comparable to WTD and mule deer, about 75% of conceptions occurred during a period of 15 days. These data are the same as reported by Brown (1961) for CBT in Washington.

Morphological Measurements

Whole weights, eviscerated weights, external measurements, organ weights, KFI, rump fat depth, and percent fat in femur marrow, by age, are given in Tables 2 and 3. Chest girth, whole body weights, and number of fetuses were compared (Fig. 7) in an effort to detect a usable measure of condition that could be correlated with reproductive success. The only conclusion that can be drawn is that middle-age females which weigh in excess of 40 kg produce the greatest number of fawns. Zwank (1979) reported a significant correlation between body condition of mule deer does and reproductive success. Similar correlations could probably be demonstrated in SBT if larger samples were available.

Diseases and Parasites

When compared with other members of the deer family, the SBT of southeastern Alaska are remarkably free of diseases and parasites. However, parasitological examinations have generally been cursory and opportunistically pursued. Klein (1965) documented the occurrence of only 1 species of ectoparasite, a tick (Dermacentor sp.), on Coronation Island. Klein (1959) reported lungworm, Dictyocaulus viviparus, (which was misidentified as D. filaria), to be common. Neiland (1960) and Klein (1963) examined deer from Woronkofski and Coronation Islands and detected the presence of lungworm, the caecal nematode Oesophagostomum venulosum, larval forms of 2 species of Taenia, and nasal bots, Cephenemyia jellisoni. Merriam (1960) reported a heavy infestation of lungworm and nasal bots in a winter-killed fawn from Helm Bay. Johnson, (1982, and unpubl. data) made opportunistic parasitological observations of deer from Admiralty, Baranof, Chichagof, and Kruzof Islands and Prince William Sound and reported low occurrence of cattle lice, Tricholipeurus lipeuroides, caecal nematodes, adult tape worms (probably of the genus Monizia), a

high occurrence of lungworm in fawn and yearling animals and a 100% occurrence of trichostrongylid nematodes, (Ostertagia spp., Trichostrongylus spp., and Haemonchus spp.) in the abomasum of deer. Johnson (1982) also observed larval forms of tape worm (likely T. hydatigena, W. Samuel, pers. commun.) in the musculature of several deer examined in the vicinity of Sitka, where free-ranging dogs have replaced wild canids as the definitive host for Taenia. Nasal bots have been observed in 2 deer from Game Management Unit 4, but examinations have been very minimal (Johnson, unpubl. data). Rausch and Williamson (1959) documented 1 specimen of Echinococcus granulosis from a deer collected on Baranof Island. Neiland (1981) has tested deer from various locations in southeastern Alaska and found a 17% occurrence of the protozoan Sarcocystis spp.

Recently, Foreyt (pers. commun.) identified coccidiosis (Eimeria sp.) and larvae of the muscle worm (Parelaphostrongylus odocoilei) in a small sample of pellets collected on Baranof Island.

Parasites of wild animals are of significance from 2 perspectives: impacts on their host and on man. Parasites of deer appear to pose little threat to human health because of the very low occurrence of the only potential pathogen, E. granulosis. A child did sustain an infection of this organism in Juneau, Alaska, in fall 1985. That infection probably came from the family pet German shepherd because transmission to man from the alternate host is unknown.

The impact of diseases and parasites on Alaskan deer are typically thought to be of little consequence. Deer with heavy infestations of lice are never thrifty (pers. observ.), but the occurrence of this parasite is low. Experimental infection of Sarcocystis spp. in mule deer (O. h. hemionus) fawns has resulted in 75% mortality (Hudkins and Kistner 1977), suggesting this organism to be a potential pathogen. Cowan (1951) associated the caecal nematode with deer mortality on Vancouver Island.

Lungworm and its most commonly associated disease, verminous pneumonia, is known worldwide and is a serious threat to its host. The notoriety of lungworm pathogenicity is mainly due to its association with pneumonia (Dau 1981). Cowan (1951) observes that "This [lungworm] is one of the most damaging of the parasites of big game and has been the cause of several epidemic die-offs of deer on southern Vancouver Island and on Bowen and Gambier Islands." Jorgensen and Vigh-Larsen (1986) caution the deer- (Cervus elaphus and Dama dama) farming industry in Europe of the potential hazard of lungworm outbreaks. Dr. William Longhurst, who has extensive experience with parasites of wild ungulates, described this as

the most toxic of parasites (pers. commun.). Dunn (1969) reports lungworm to be a parasite of young animals and one that is often associated with high mortality. Blood et al. (1983) describe the significance of verminous pneumonia in domestic cattle and noted that animals less than 10 months of age are most often affected. Southeastern Alaska, with its mesic and relatively mild climatic conditions, appears to be well suited to lungworm. Dunn (1969) reports that lungworm larvae may live for as long as 1 year under warm, moist conditions. Lungworm infestations in deer are density dependent and together with other parasite lodes, may provide a measure of deer herd health, range conditions, and density (Foreyt and Samuel 1979). W. Samuel and W. Foreyt (pers. commun.) believe lungworm infections are primarily pathogenic to young animals and that healthy adults or those that survive infections as young are immune or resistent to further infections. Recent experimental research (Foreyt, pers.commun.) on mule and WTD indicates a threshold level of lungworm larvae innoculation causing death of the fawn within 20 days. Innoculation levels below that threshold do not cause death and actually may result in immunity to the parasite, but reduced growth of the host fawn generally follows. I have provided Foreyt with lungs of infected fawn SBT's. His histopathological report concluded that "There is no question that verminous pneumonia of this degree would result in death." Sixty-seven individual worms were recovered from 1 specimen.

Parasitological examinations were carefully conducted during autopsy of the collected deer. These observations are summarized in Table 4 and are in general agreement with published accounts discussed above. Unfortunately, examinations for nasal bots were not conducted. It is possible that seasonal variations in parasite lode (Foreyt and Samuel 1979) may occur. A "spring rise" and another rise in parasite numbers at the time of weaning have been observed with lungworm (Foreyt, pers. commun.; Jorgensen and Vigh-Larsen 1986). It is significant that lungworm occurred in 100% of the fawn sample. Additionally, it is significant that the degree of infection and probably the pathogenic impact of such an infection, could possibly result in near or total loss of a particular year's age class. In fact, a loss such as this may have already occurred because we only obtained 3 yearling does in the sample collection, even though does were collected nonselectively. The significance of these observations is that a series of severe winters could reduce the adult segment of the deer population through malnutrition. Recruitment would be diminished, through loss of annual production to lungworm infections and its complications, resulting in a slow recovery of the population. This could explain why deer populations in southern Southeast Alaska have been so slow to recover following the severe die-offs of the late 1960's.

Unfortunately, eruptions of disease/parasite infections in wild populations are nearly impossible to treat. Though lungworm is very treatable with low-level dosages of ivermectin (W. Foreyt, pers. commun.), administration of the drug would be impractical.

Rumen Analyses

Dietary habits of the genus Odocoileus have been widely studied and reported in North America (see Wallmo 1978, 1981). Specific documentation of the food habits of the SBT of Southeast Alaska is more limited. Alaska deer literature is replete with references to "key" or "important" plant species as deer food. (See Klein 1963, 1965; Olson and Klein 1959; Merriam 1960 and subsequent Federal Aid reports; Wallmo and Schoen 1980; etc.) These documents list Vaccinium ovalifolium, V. parvifolium, Coptis asplenifolia, Rubus pedatus, and Cornus canadensis as being key food items. However, the criteria used to determine importance are not described; apparently those selections were intuitive or based on apparent or observed deer use. The importance of conifer foliage has been considered insignificant, although utilization of wind-thrown Alaska yellow cedar (Chamaecyparis nootkatensis) (Klein, 1979) and hemlock (Tsuga heterophylla) (Klein 1956, Klein and Olson 1960) in winter has been reported. The use of kelp (Fucus sp.) during winter is commonly noted (Klein 1956; Klein and Olson 1960).

Merriam (1960) and Klein (1962) described the chemical composition of deer rumen contents but did not report species composition. Pierce (1981) provides the 1st report of SBT food items through microhistological examination of fecal material, noting that coniferous foliage composed 45% of the foods utilized; Vaccinium spp., 20%; Cornus canadensis, 10%; ferns, 10%; and lichens, moss, and liverworts, 12%. Pierce's samples were collected during winter on Prince of Wales Island but reference was not made to the severity of the winter. Schoen et al. (1982) reported a comparison of paired rumen and fecal samples examined microhistologically from a sample of deer collected during late winter 1981 on Admiralty and Chichagof Islands. They found reasonably close agreement in the composition of rumen and fecal materials in their paired samples. By percent composition, their rumen analyses showed conifer, 18; half shrubs, 42; forbs, 15; and shrub, 17. Vaccinium spp. composed only 1% of their sample. Hanley and McKendrick (1985) micro-histologically examined winter-deposited fecal samples from Hawk Inlet, Admiralty Island. They found data comparable to Schoen et al.'s (1982), except yellow cedar was absent from their sample as it does not occur in their study site.

Rumen samples were taken from the February collection and preserved in 10% formalin. Results, displayed in Table 5, show conifer foliage, half shrubs, forbs, kelp, grass/sedges, lichens, shrubs, and moss/ferns to compose 47, 26, <1, 7, 8, 4, 3, and 3%, respectively, of the items eaten. Hemlock, yellow cedar, and Vaccinium spp. combined made up 69% of the total.

These 3 items were also the only ones with 100% frequency of occurrence.

These data are comparable to those reported by Pierce (1981), except lichens were poorly represented in this sample for unknown reasons. These findings are at considerable variance from those of Schoen et al. (1982) and Hanley and McKendrick (1985). However, their data were collected during mild weather when the deer were free to select preferred food items, most notably Cornus canadensis which made up over 30% of their samples; Rubus pedatus and other forbs and shrubs made up an additional 39%. During the 1985 collection, snow accumulated to about 1 m at sea level, which reduced or eliminated availability of preferred forbs and forced deer to rely primarily on conifers and Vaccinium.

This analysis is significant from 3 perspectives: First, it confirms the necessity of maintaining quality, old-growth forest habitat with its greater variety and availability of food items during winter. Second, during periods of extreme snow accumulation deer are forced to rely on woody vegetation (yellow cedar, hemlock, and Vaccinium spp.) that does not provide minimum dietary requirements (Taber 1956, Wallmo et al. 1977, Wallmo 1978, Billings and Wheeler 1979, Hanley and McKendrick 1985). These data also show the importance of relating winter severity to food habits analyses.

Blood Analysis

Packed cell volume (PCV), hemoglobin (HGB), and blood chemistry data are presented in Table 6 and their units of measurements are given in Table 7. PCV and HGB values were within ranges for SBT reported by Cowan and Bandy (1969). I was not able to locate published accounts of blood chemistry values for SBT, so no comparisons were made. Most values appear to be within the range of mean values for mule and CBT as summarized by Anderson (1981).

Franzmann and LeResche (1978) reported that PCV provides a usable value for condition assessment in moose (Alces alces). PCV values from this sample were compared with other condition values such as fat content of femur marrow, KFI, and rump fat deposition. No significant ($P>0.1$) relationships were found.

When compared with average PCV values for moose, these PCV values suggested that the deer were in the area of "relative goodness" (Franzmann, pers. commun.).

RECOMMENDATIONS

This study provides a good understanding of the reproductive potential of the SBT in southeastern Alaska. The annual increment into the deer population from the annual reproductive effort is not known. The age structure of the deer population is also unknown. These 2 variables must be determined before the population dynamics of the SBT can be understood. It is therefore recommended that future research be directed toward developing a technique to determine survivorship through at least 1 year of age and to develop a technique to assess the age structure of the population.

The reproductive data reported here were obtained from a population of deer that is suspected of being at pristine levels following a series of mild winters. These data probably represent the maximum reproductive effort for SBT under a high, but not stationary, population density. Reproductive effort could vary under conditions such as a population decline or a rapid expansion following a weather-induced reduction. Productivity should be evaluated under the latter scenarios when they occur.

Lungworm may be a major mortality factor on SBT during their 1st year of life. That hypothesis should be tested and, if proven, control measures may be necessary.

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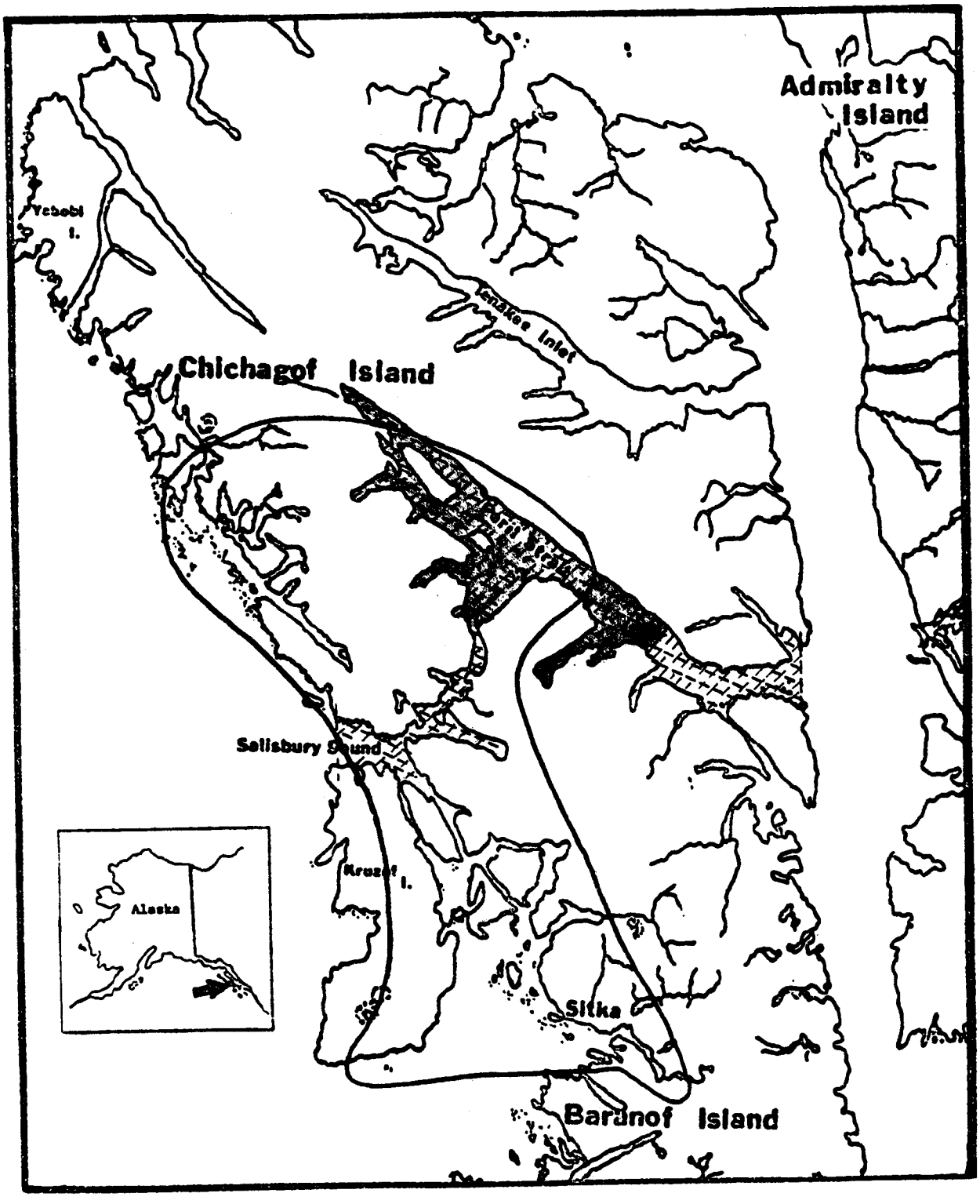

Figure 1. Hoonah Sound study area (cross-hatched). Sitka black-tailed deer collected only from within shaded area. Specimens obtained from hunters were taken from within the heavy line.

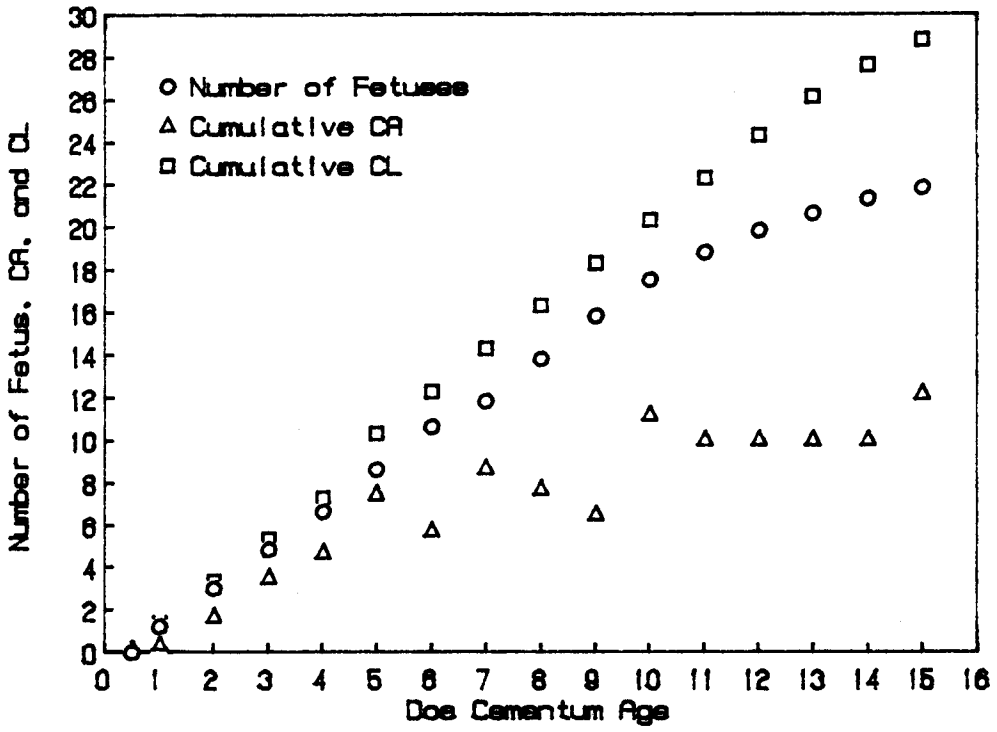

Figure 2. Cumulative CL and fetus counts in Sitka black-tailed deer collected in February 1985, Hoonah Sound, Alaska. Total mean CA counts from February 1985 collection and fall 1985 hunter kills are combined.

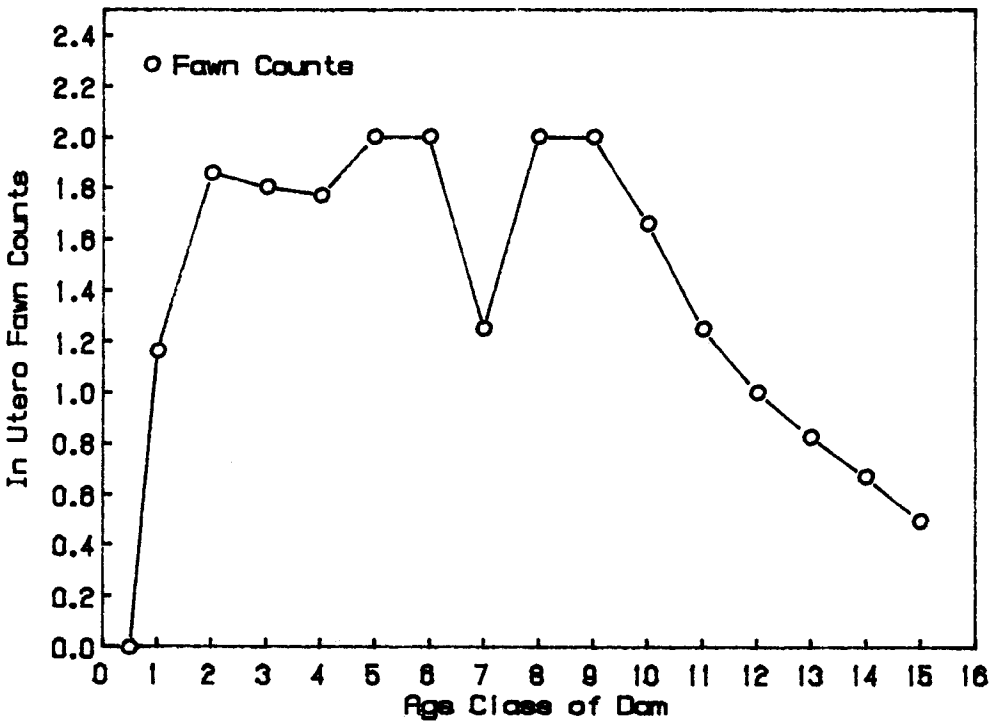

Figure 3. In utero mean fetus counts in Sitka black-tailed deer collected in February 1985, Hoonah Sound, Alaska. Data for ages 11, 13, and 14 were extrapolated.

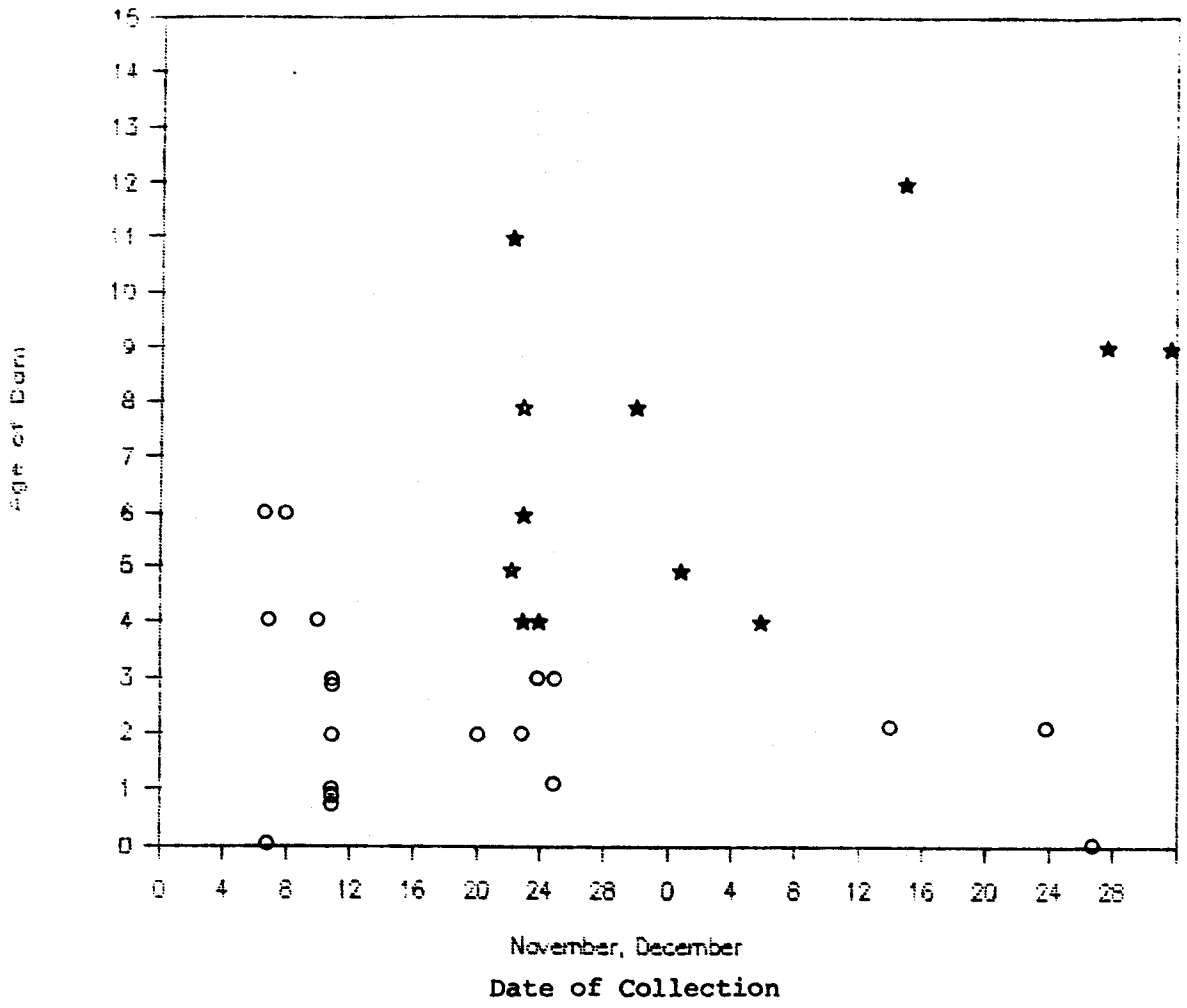

Figure 4. Pregnancy status of Sitka black-tailed deer killed by sport/ subsistence hunters from the Sitka-Hoonah Sound area of Alaska Nov. - Dec., 1985 based on presence (*) or absence (o) of CL.

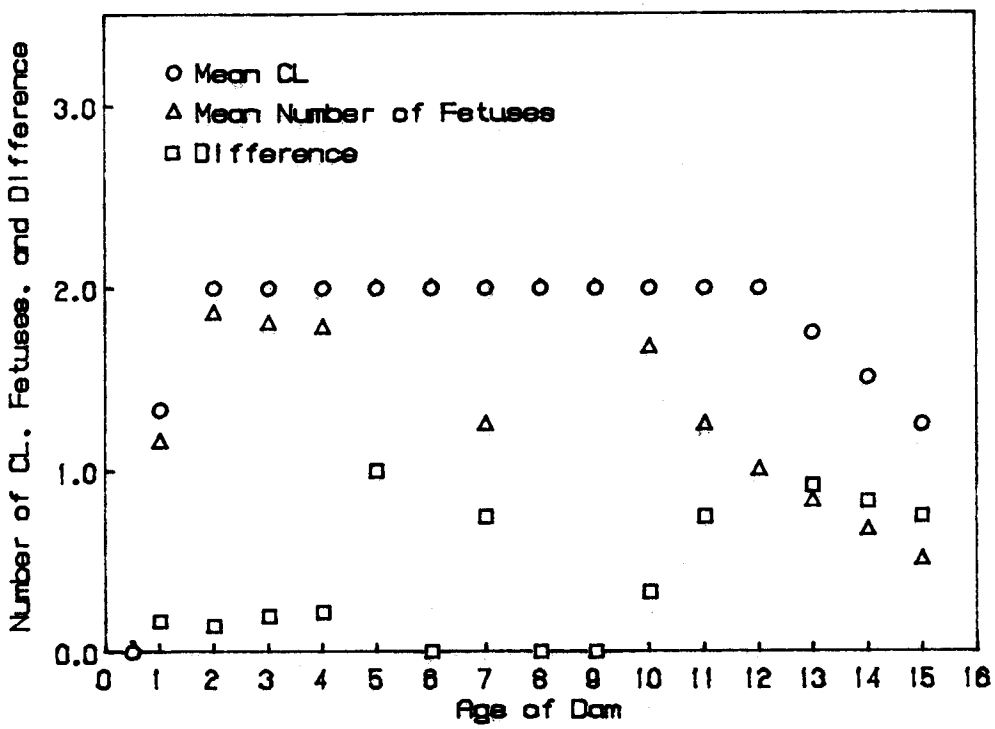

Figure 5. Early pregnancy fetal mortality of Sitka black-tailed deer collected in February 1985, Hoonah Sound, Alaska. Ages 5 and 7 are not included in the "Difference" curve as they are considered aberrant.

*CL = corpora lutea

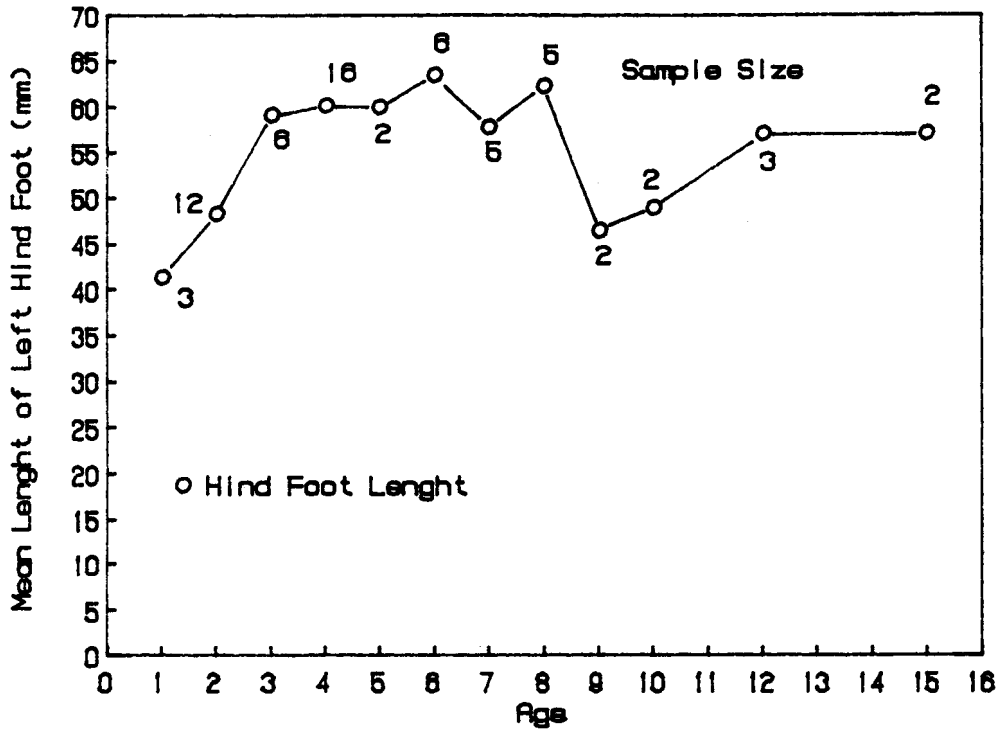

Figure 6. Comparison of hind foot length (HFL) of fetus to age of dam of Sitka black-tailed deer collected February 1985, Hoonah Sound, Alaska.

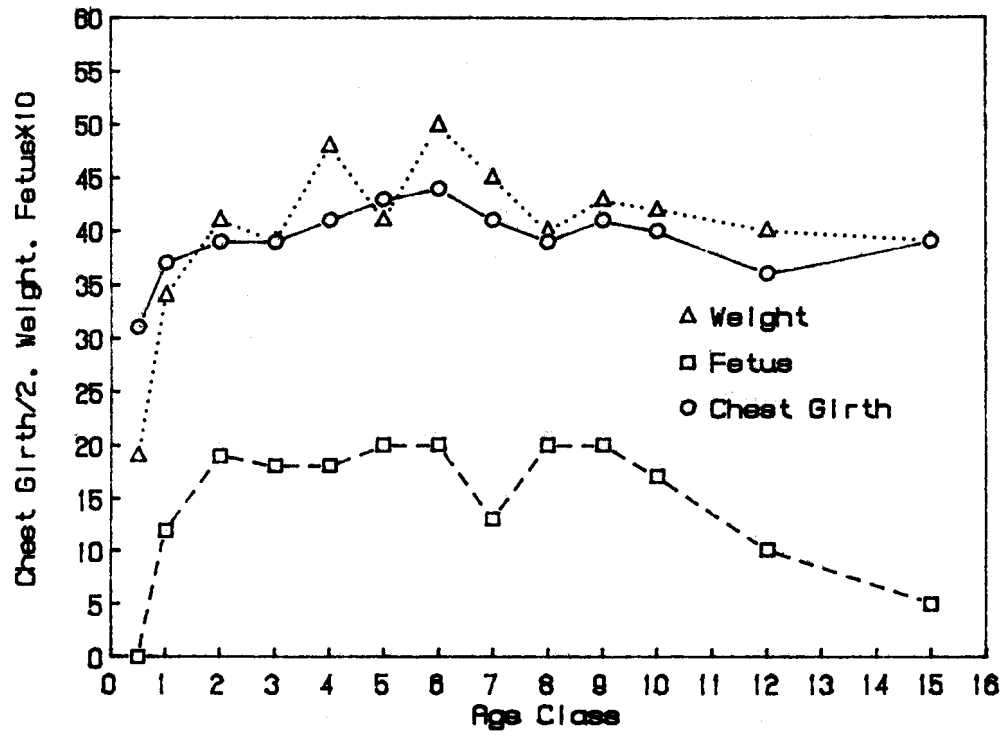

Figure 7. Chest girth in cm (÷ 2), weight in kg, and age of dam compared to fetus numbers (x 10) of Sitka black-tailed deer collected in February 1985, Hoonah Sound, Alaska.

Table 1. Ovarian and reproductive tract analyses for Sitka black-tailed deer collected in the Stika-Hoonah Sound area, 1985.

Age	Mean No. fetuses[a]	Cumulative CL in Utero fetus counts[a]	Mean No. fertilized ova based on CL counts[a]	Cumulative corpora lutea counts[a]	Mean Total CA counts[b]	Sample Size Feb. Coll.[a]	Hunter kill[b]
Fawn	0.00	0.00	0.00	0.00	0.00	7	3
1	1.16	1.16	1.33	1.33	0.42	3	8
2	1.86	3.02	2.00	3.33	1.73	7	7
3	1.80	4.82	2.00	5.33	3.55	5	6
4	1.77	6.60	2.00	7.33	4.71	10	5
5	2.00	8.60	3.00	10.33	7.50	1	6
6	2.00	10.60	2.00	12.33	5.67	3	5
7	1.25	11.85	2.00	14.33	8.71	4	-
8	2.00	13.85	2.00	16.33	7.71	3	3
9	2.00	15.85	2.00	18.33	6.50	1	3
10	1.66	17.52	2.00	20.33	11.25	3	-
11	1.25[c]	18.77[c]	2.00	22.33[c]	10.00	-	1
12	1.00	19.77	2.00	24.33	10.00	1	1
13	0.83[c]	20.60[c]	1.75[c]	26.08[c]	--	-	-
14	0.67[c]	21.27[c]	1.50[c]	27.58[c]	--	-	-
15	0.50	21.77	1.25	28.83	12.25	4	-

[a] These data were obtained from deer collected in Hoonah Sound, Alaska in February, 1985.

[b] These data were obtained from deer collected in Hoonah Sound, Alaska in February, 1985 and from deer killed by Sport/Subsistence hunters in the Sitka-Hoonah Sound, Alaska area in Sept.-Dec., 1985.

[c] Extrapolated

Table 2. Morphological measurements of female Sitka black-tailed deer collected at Hoonah Sound, Alaska, February 1985.

Age	Total length min.-max.(N) avg. (cm)	Head length min.-max.(N) avg. (cm)	Head width min.-max.(N) avg. (cm)	Neck circum. min.-max.(N) avg. (cm)	Chest girth min.-max.(N) avg. (cm)	Shoulder ht min.-max.(N) avg. (cm)	Hind foot length min.-max.(N) avg. (cm)	Tail length min.-max.(N) avg. (cm)
Fawn	99-105(7) 101.0	19-20(7) 19.5	8-9(6) 8.5	20-26(7) 23.4	57-67(6) 61.8	63-74(6) 68.3	34-37(7) 34.7	8-12(7) 10.8
1	108-117(3) 113.0	23-23(3) 22.8	10-10(3) 10.2	28-29(3) 28.7	72-77(3) 73.8	79-86(3) 82.6	38-40(3) 39.1	11-13(3) 11.9
2	116-132(7) 124.0	23-25(7) 24.0	10-11(7) 10.6	27-32(7) 29.3	74-84(7) 78.7	78-85(7) 81.9	38-42(7) 40.1	10-15(7) 12.3
3	113-138(5) 124.7	23-24(5) 23.8	10-11(5) 10.3	28-31(5) 30.2	75-84(5) 78.9	76-89(5) 82.3	38-41(5) 39.7	11-13(5) 12.2
4	122-146(10) 132.5	24-26(10) 24.9	10-11(10) 10.7	30-36(10) 32.3	67-89(10) 82.7	70-88(10) 83.9	39-42(10) 41.0	10-14(10) 12.2
5	128(1)	25(1)	11(1)	31(1)	86(1)	90(1)	40(1)	13(1)
6	123-131(3) 127.3	24-26(3) 25.1	11-11(3) 11.0	30-34(3) 31.3	83-94(3) 87.5	84-93(3) 88.9	41-42(3) 41.5	10-13(3) 11.8
7	120-135(5) 128.0	23-25(5) 24.5	10-11(5) 10.5	29-41(5) 32.7	73-86(5) 82.1	82-85(4) 83.7	38-40(5) 39.7	9-13(5) 11.3
8	125-135(3) 131.2	23-25(3) 24.5	10-11(3) 10.5	28-35(3) 31.0	75-79(2) 77.3	77-85(3) 82.0	39-42(3) 40.3	11-13(3) 12.2
10	117-133(3) 124.5	23-25(3) 24.4	11-11(3) 11.1	31-33(3) 31.6	76-84(3) 80.6	75-88(3) 82.8	37-42(3) 39.3	10-10(3) 9.8
12	128(1)	24(1)	10(1)	28(1)	72(1)	81(1)	39(1)	11(1)
15	122-131(4) 128.7	24-25(4) 24.2	10-11(4) 10.5	26-29(4) 28.1	76-58(3) 77.5	82-84(3) 83.0	38-39(4) 38.5	11-13(4) 11.8

Table 3. Weights, kidney fat indices (KFI), rump fat depths, and fat content of femur marrow of female Sitka black-tailed deer collected at Hoonah Sound, Alaska, February 1985.

Age	Whole wt min.-max.(N) avg. (kg)	Evisc. wt min.-max.(N) avg. (kg)	Liver wt min.-max.(N) avg. (gm)	Heart wt min.-max.(N) avg. (gm)	Kidney w/o fat wt min.-max.(N) avg. (gm)	KFI min.-max.(N) avg.	Rump fat min.-max.(N) avg. (cm)	% fat femur min.-max.(N) avg.
Fawn	17-24(7)	13-16(7)	289-352(7)	123-157(7)	32-39(7)	0.06-0.29(7)	0.00-0.00(7)	20-88(7)
	19.3	14.2	330.6	137.1	34.6	0.15	0.00	63.4
1	31-39(3)	23-27(3)	420-515(7)	218-253(3)	47-54(3)	0.39-0.84(3)	0.00-0.30(3)	89-92(3)
	34.1	24.5	476.9	241.0	51.0	0.55	0.10	89.8
2	36-47(7)	25-33(7)	462-620(7)	261-324(7)	40-66(7)	0.38-1.21(7)	0.10-1.30(7)	87-93(7)
	40.7	28.8	524.7	289.5	51.7	0.84	0.44	89.3
3	34-48(5)	23-35(5)	490-632(3)	257-379(3)	48-69(4)	0.35-1.19(4)	0.20-1.20(5)	84-92(5)
	39.2	28.6	553.9	303.0	55.3	0.80	0.84	89.2
4	42-54(10)	28-39(10)	477-740(10)	300-381(10)	51-68(9)	0.84-1.40(9)	0.50-2.50(10)	89-95(10)
	47.7	34.2	585.3	336.9	59.3	1.17	1.48	92.2
5	41(1)	29(1)		305(1)	61(1)	0.65(1)		91(1)
6	46-54(3)	31-39(3)	522-626(3)	338(1)	62-67(3)	0.63-1.08(3)	1.20-2.30(3)	88-94(3)
	49.6	34.8	587.8		64.0	0.88	1.85	91.0
7	40-51(5)	29-34(5)	517-623(5)	305-375(4)	51-74(5)	0.43-0.99(5)	1.00-2.00(5)	90-94(5)
	42.1	32.0	579.2	332.0	59.3	0.79	1.26	92.2
8	35-43(3)	25-30(3)	505-568(3)	256-281(2)	56-64(2)	0.24-0.76(2)	0.00-0.80(3)	86-93(3)
	40.3	28.1	530.1	268.6	60.0	0.50	0.43	89.5
10	37-47(3)	26-35(3)	514-620(3)	260-384(3)	58-73(3)	0.14-0.84(3)	0.00-1.50(3)	75-93(3)
	41.8	30.0	584.3	325.0	63.7	0.56	0.93	86.4
12	40(1)	28(1)	542(1)	294(1)	76(1)	0.19(1)	0.00(1)	84(1)
15	37-40(4)	24-28(4)	483-648(3)	258-308(4)	65-73(4)	0.05-0.23(4)	0.00-0.00(4)	29-88(4)
	38.6	26.2	569.8	285.9	69.0	0.16	0.00	72.0

Table 4. Parasites found in Sitka black-tailed deer collected at Hoonah Sound, Alaska, February 1985.

Age of deer	Number examined	% Positive					
		Lung-worm	Abomasum nematode	Caecum nematode	Adult tape	Tape cysticerci	Ectoparasite
Fawn	7	100	100	0	0	0	0
1	3	0	100	0	0	0	0
2	7	0	100	0	0	0	0
3	5	0	100	0	0	0	0
4	10	0	100	0	0	0	0
5	1	0	100	0	0	0	0
6	3	0	100	0	0	0	0
7	4	0	100	0	1	0	0
8	3	0	100	0	0	0	0
9	1	0	100	0	0	0	0
10	3	0	100	0	0	0	0
12	1	1	100	0	0	0	0
15	4	0	100	0	0	0	0

Table 5. Rumen analysis of Sitka black-tailed deer collected at Hoonah Sound, Alaska, February 1985.

Plant group	% Composition	Range	% Occurrence
Total conifer	47	11-87	100
Chamaecyparis nootkatensis	15	<1-56	100
Tsuga heterophylla	30	2-82	100
Picea sitchensis	<1	0-3	36
Conifer bark	2	1-21	72
Total half-shrubs	26	1-60	100
Vaccinium spp.	24	1-59	100
Cornus canadensis	2	0-21	41
Rubus pedatus	<1	0-4	31
Forbs	1	0-12	43
Shrubs	3	0-14	89
Kelp	7	0-40	98
Mosses	1	0- 6	66
Ferns	2	0-67	40
Lichens	4	0-17	95
Grasses/sedges	8	0-55	81

Table 7. Blood chemistry and units of measurements.

Acronym	Value	Unit of Measurement
CALCIUM	calcium	mg/100 ml
IN PHOS	inorganic phosphorus	mg/100 ml
GLUCOSE	glucose	mg/100 ml
BUN	blood urea nitrogen	mg/100 ml
URIC AC	uric acid	mg/100 ml
CHOLEST	cholestrol	mg/100 ml
TOT PROT	total protein	g/100 ml
ALBUMIN	albumin	g/100 ml
GLOBULIN	globulin	g/100 ml
A:G	albumin:globulin	ratio
TOT BILI	total biliruben	mg/100 ml
ALK PHOS	alkaline phosphatase	units/lit
LDH	lactic dehydrogenase	mg/100 ml
SGOT	serum glutamic-oxaloacetic	units/lit
SGPT	serum glutamic-pyruvic	units/lit
CREAT	creatinine	mg/100 ml
BUN:CRT	bun:creat	ratio
IRON	iron	microgram/100 ml
TRIG	triglycerides	mg/100 ml
T LIPIDS	total lipids	mg/100 ml
SODIUM	sodium	milliequivalents/lit
POTAS	potassium	milliequivalents/lit
CHLORIDE	chloride	milliequivalents/lit
GGTP	gamma glutamyl transferase	units/lit
HGB	hemaglobin	g/100 ml
PCV	packed cell volume	percent

Table 6. Blood chemistry for individual female Sitka black-tailed deer collected at Hoonah Sound, Alaska, February 1985.

ACC NO	AGE	CALCIUM	IN PHOS[a]	GLUCOSE	BUN	URIC AC	CHOLEST	TOT PROT	ALBUMIN	GLOBULIN	A:G	TOT BILI	ALK PHOS
83142	2.0	9.3	8.2	83.0	9.0	0.1	47.0	7.8	3.4	4.4	0.8	0.2	16.0
83144	6.0	7.6	16.5	17.0	3.0	0.4	48.0	6.9	3.1	3.8	0.8	0.1	27.0
83145	4.0	9.3	13.3	18.0	11.0	0.5	57.0	7.0	3.2	3.8	0.9	0.1	9.0
83146	15.0	7.8	6.2	17.0	19.0	0.3	61.0	7.1	2.0	5.1	0.4	0.1	27.0
83147	4.0	9.5	9.3	161.0	8.0	0.2	63.0	7.1	3.0	4.1	0.7	0.1	47.0
83148	15.0	8.5	5.4	119.0	12.0	0.1	67.0	7.0	2.6	4.4	0.6	0.2	27.0
83149	0.5	10.3	9.0	185.0	14.0	0.1	56.0	7.1	3.1	4.0	0.8	0.1	65.0
83150	4.0	10.4	7.7	80.0	16.0	0.4	57.0	7.2	3.4	3.8	0.9	0.3	25.0
83151	7.0	9.3	8.4	109.0	9.0	0.1	62.0	6.8	3.0	3.8	0.8	0.2	32.0
83152	4.0	9.4	8.3	104.0	10.0	0.1	46.0	6.9	3.1	3.8	0.8	0.2	18.0
83153	3.0	9.6	9.0	107.0	9.0	0.4	48.0	6.7	2.9	3.8	0.8	0.2	25.0
83155	0.5	9.7	6.9	149.0	9.0	0.2	51.0	6.3	2.5	3.9	0.6	0.1	63.0
83156	0.5	--	--	--	--	--	--	--	--	--	--	--	--
83158	1.0	--	--	--	--	--	--	--	--	--	--	--	--
83159	2.0	9.0	7.6	117.0	4.0	0.3	44.0	6.7	2.7	4.0	0.7	0.1	93.0
83160	3.0	10.1	5.7	6.0	13.0	0.1	42.0	8.3	3.2	5.1	0.6	0.4	39.0
83161	2.0	9.4	8.1	5.0	25.0	0.1	55.0	7.4	3.0	4.5	0.7	0.2	36.0
83162	10.0	9.1	6.5	7.0	7.0	0.1	48.0	6.9	2.3	4.6	0.5	0.7	17.0
83163	7.0	--	--	--	--	--	--	--	--	--	--	--	--
83164	NA	--	--	--	--	--	--	--	--	--	--	--	--
83165	0.5	9.4	18.0	6.0	3.0	2.1	38.0	6.5	2.5	4.0	0.6	0.3	32.0
83166	3.0	9.4	7.3	5.0	5.0	0.5	51.0	7.1	2.9	4.2	0.7	0.2	34.0
83167	15.0	8.8	7.1	5.0	19.0	0.1	63.0	6.4	2.5	3.9	0.7	0.3	101.0
83169	0.5	8.8	7.4	5.0	8.0	0.1	45.0	5.7	2.3	3.4	0.7	0.2	96.0
83171	1.0	8.6	6.3	5.0	2.0	0.3	39.0	7.2	3.0	4.2	0.7	0.2	29.0
83172	2.0	9.9	6.9	56.0	8.0	0.2	69.0	8.0	3.5	4.5	0.8	0.3	27.0
83174	2.0	9.4	8.9	68.0	8.0	0.3	50.0	6.9	3.2	3.7	0.9	0.1	16.0
83175	10.0	8.7	6.9	31.0	5.0	0.5	52.0	6.3	2.7	3.6	0.7	0.3	18.0
83176	2.0	9.2	6.3	5.0	9.0	0.2	54.0	7.1	3.0	4.1	0.7	0.2	24.0
83177	4.0	10.2	10.8	5.0	14.0	0.2	67.0	7.1	3.2	3.9	0.8	0.1	13.0
83178	8.0	--	--	--	--	--	--	--	--	--	--	--	--
83180	0.5	8.9	7.1	6.0	15.0	0.1	49.0	6.0	2.4	3.6	0.7	0.3	37.0
83182	6.0	0.0	7.8	5.0	10.0	0.2	65.0	6.7	2.8	3.9	0.7	0.2	35.0
83183	8.0	9.2	7.5	5.0	3.0	1.0	54.0	6.5	2.6	4.0	0.6	0.2	16.0
83185	10.0	10.8	7.8	5.0	5.0	0.1	78.0	8.3	3.6	4.7	0.8	0.2	26.0
83188	1.0	9.7	4.2	6.0	13.0	0.1	42.0	7.0	2.8	4.3	0.6	0.2	22.0
83189	4.0	9.5	5.9	81.0	10.0	0.1	53.0	6.8	3.3	3.5	0.9	0.2	18.0
83190	6.0	8.7	8.3	17.0	6.0	0.1	56.0	7.0	2.7	4.3	0.6	0.2	41.0
83191	4.0	11.0	9.9	8.0	4.0	1.9	60.0	7.3	3.3	4.0	0.8	0.5	42.0
83192	4.0	9.5	7.3	105.0	9.0	0.6	48.0	7.0	3.0	4.0	0.7	0.2	32.0
83193	7.0	8.1	8.9	5.0	4.0	0.1	47.0	7.1	2.7	4.4	0.6	0.3	38.0
83194	0.5	6.4	13.5	4.0	4.0	2.0	30.0	6.2	1.7	4.5	0.4	0.2	105.0
83195	2.0	10.7	10.2	42.0	11.0	0.3	42.0	7.9	3.2	4.7	0.7	0.1	37.0

[a] See Table 7 for complete names and units of measurement.

Table 6. Continued.

ACC NO	AGE	LDH	SGOT	SGPT	CREAT	BUN:CRT	IRON	TRIG	T LIPIDS	SODIUM	POTAS	CHLORIDE	GGTP	HGB	PCV
83142	2.0	329.0	73.0	24.0	1.8	5.0	192.0	25.0	212.0	139.0	10.1	104.0	68.0	14.7	53.2
83144	6.0	--	--	338.0	1.8	2.0	344.0	125.0	316.0	141.0	12.4	106.0	90.0	--	--
83145	4.0	329.0	250.0	32.0	1.7	7.0	267.0	32.0	241.0	153.0	6.3	120.0	77.0	--	--
83146	15.0	370.0	219.0	45.0	1.1	18.0	254.0	57.0	275.0	142.0	7.2	96.0	--	--	--
83147	4.0	424.0	187.0	25.0	1.9	4.0	149.0	63.0	284.0	147.0	8.0	105.0	253.0	--	--
83148	15.0	512.0	175.0	29.0	1.8	7.0	135.0	32.0	263.0	148.0	6.6	101.0	97.0	14.8	54.3
83149	0.5	481.0	68.0	36.0	1.7	8.0	136.0	50.0	257.0	147.0	9.1	98.0	60.0	14.6	52.7
83150	4.0	324.0	157.0	37.0	1.9	9.0	374.0	39.0	249.0	150.0	8.2	103.0	91.0	--	--
83151	7.0	293.0	52.0	22.0	1.7	5.0	139.0	56.0	276.0	148.0	6.2	105.0	64.0	14.7	53.8
83152	4.0	287.0	49.0	32.0	1.6	6.0	208.0	25.0	210.0	146.0	5.1	102.0	76.0	--	--
83153	3.0	216.0	145.0	25.0	1.6	6.0	181.0	26.0	215.0	152.0	7.5	104.0	74.0	10.6	39.0
83155	0.5	311.0	61.0	42.0	1.2	8.0	116.0	39.0	236.0	142.0	8.4	99.0	102.0	11.8	42.2
83156	0.5	--	--	--	--	--	--	--	--	--	--	--	--	14.2	50.9
83158	1.0	--	--	--	--	--	--	--	--	--	--	--	--	8.6	28.3
83159	2.0	286.0	94.0	31.0	1.8	2.0	180.0	84.0	266.0	145.0	7.8	104.0	76.0	--	--
83160	3.0	263.0	75.0	26.0	1.9	7.0	--	23.0	200.0	145.0	8.0	103.0	71.0	16.7	59.5
83161	2.0	236.0	55.0	39.0	1.8	14.0	--	30.0	233.0	143.0	7.4	104.0	74.0	16.3	56.1
83162	10.0	308.0	59.0	36.0	2.0	3.0	--	16.0	204.0	137.0	11.5	96.0	70.0	--	--
83163	7.0	--	--	--	--	--	--	--	--	--	--	--	--	17.0	59.5
83164	NA	--	--	--	--	--	--	--	--	--	--	--	--	15.7	57.0
83165	0.5	490.0	819.0	66.0	0.8	3.0	--	39.0	207.0	151.0	9.0	105.0	335.0	14.0	50.5
83166	3.0	189.0	146.0	35.0	1.4	4.0	215.0	30.0	226.0	143.0	12.0	99.0	66.0	10.0	39.3
83167	15.0	236.0	73.0	31.0	1.4	14.0	235.0	60.0	281.0	143.0	9.5	100.0	72.0	--	--
83169	0.5	250.0	73.0	38.0	1.1	7.0	255.0	78.0	261.0	143.0	10.0	93.0	68.0	12.0	43.0
83171	1.0	88.0	95.0	41.0	1.3	1.0	--	11.0	181.0	141.0	7.8	102.0	106.0	--	--
83172	2.0	317.0	57.0	38.0	2.0	4.0	--	31.0	267.0	143.0	8.7	98.0	92.0	--	--
83174	2.0	257.0	72.0	36.0	1.8	5.0	--	13.0	208.0	142.0	8.7	100.0	76.0	14.7	51.6
83175	10.0	72.0	67.0	39.0	1.4	3.0	291.0	14.0	213.0	145.0	5.9	98.0	94.0	13.9	49.5
83176	2.0	312.0	80.0	37.0	1.5	6.0	--	38.0	242.0	143.0	9.4	102.0	64.0	13.2	47.1
83177	4.0	290.0	87.0	41.0	1.7	8.0	--	12.0	244.0	150.0	8.0	104.0	89.0	15.0	52.9
83178	8.0	--	--	--	--	--	--	--	--	--	--	--	--	10.9	39.7
83180	0.5	390.0	101.0	57.0	1.0	15.0	--	35.0	227.0	137.0	9.7	91.0	101.0	--	--
83182	6.0	258.0	78.0	33.0	1.7	6.0	--	64.0	290.0	146.0	6.4	104.0	62.0	--	--
83183	8.0	338.0	148.0	58.0	1.4	2.0	--	35.0	238.0	143.0	10.4	102.0	80.0	11.7	41.2
83185	10.0	347.0	101.0	35.0	1.6	3.0	--	23.0	278.0	160.0	9.1	118.0	81.0	12.6	46.0
83188	1.0	357.0	142.0	39.0	1.5	8.0	255.0	14.0	190.0	141.0	9.4	101.0	71.0	12.7	45.1
83189	4.0	275.0	53.0	24.0	1.8	6.0	190.0	37.0	238.0	141.0	9.9	104.0	76.0	14.7	53.1
83190	6.0	3140.0	3290.0	92.0	1.8	3.0	325.0	47.0	255.0	139.0	10.3	103.0	31.0	--	--
83191	4.0	269.0	281.0	37.0	1.4	3.0	280.0	96.0	312.0	159.0	8.5	105.0	156.0	15.6	56.1
83192	4.0	290.0	79.0	33.0	1.4	6.0	--	34.0	224.0	141.0	10.0	102.0	135.0	--	--
83193	7.0	1090.0	705.0	60.0	1.4	3.0	357.0	34.0	222.0	146.0	8.7	103.0	84.0	--	--
83194	0.5	500.0	499.0	338.0	1.1	3.0	--	136.0	287.0	138.0	11.7	96.0	--	--	--
83195	2.0	340.0	209.0	39.0	1.8	6.0	--	28.0	204.0	152.0	8.5	103.0	144.0	--	--