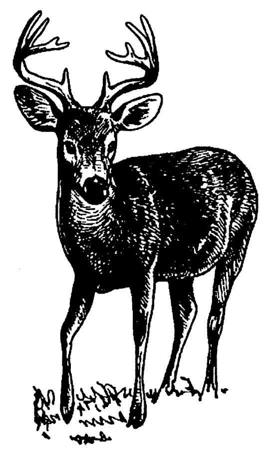
Health Assessment of White-Tailed Deer of the Cuyahoga Valley National Recreation Area, Ohio March 3-4, 1998



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Dunbar, M.R. Health Assessment of White-tailed Deer of the Cuyahoga Valley National Recreation Area, Ohio, March 3rd and 4th, 1998.

Abstract: Data from 10 white-tailed deer (Odocoileus virginianus) collected on the Cuyahoga Valley National Recreation Area (CVNRA), Ohio, on March 3rd and 4th, 1998, were analyzed and compared to data from 10 deer collected on February 3, 1997 as part of a deer herd health assessment. Low body fat indices in fawns, low fetal:doe ratios in prime age does, as well abnormal physiologic indices including a hypothyroid state and low copper, zinc and selenium levels were used to conclude that the white-tailed deer on the CVNRA have likely exceeded the carrying capacity of the habitat and are suffering from the effects of malnutrition. The deer are presently causing damage to urban gardens and landscapes, to agricultural crops, and to motor vehicles as a result of collisions on roads and highways. The deer herd is considered potentially vulnerable to adverse environmental factors and disease and in the near future may experience population declines due to malnutrition and disease.

INTRODUCTION

The Cuyahoga Valley National Recreation Area (CVNRA), located near Brecksville, Ohio, is managed by the National Park Service (NPS). Resource managers of the CVNRA have become concerned about the recent increases in number and density of white-tailed deer (WTD) (Odocoileus virginianus) on the area which have paralleled WTD population increases in the eastern United States including Ohio. During 1990-1994, deer-vehicle collisions within Summit and Cuyahoga Counties, in and near the CVNRA, have increased at an annual rate of 16 percent. Private landowners in the same general area have experienced increasing damage to gardens, landscaping, and agricultural crops due to deer feeding. In February and March of 1996, excessive fawn deer mortality occurred on the CVNRA. Because of concern for a catastrophic crash in the population and the direct and indirect effect of high deer densities on other natural resources, as well as on park visitors, the CVNRA developed a Resource Management Plan in 1993 which proposes to monitor white-tailed deer herd health and mortality. This health assessment is the second year of data collection and analysis for that plan.

The objectives of the deer herd health assessment are to: (1) provide information on the health of the deer herd by assessing body condition through gross examination and necropsy and by utilizing physiological indicators obtained through testing of blood, tissue, and feces, (2) provide information on the deer herd's exposure to infectious disease by assessing serum antibody titers to selected disease pathogens, (3) provide baseline data that will be used to monitor changes in herd health over time and to measure the response of the deer herd to resource adaptive management, (4) provide information about selected zoonotic diseases potentially carried by the deer herd, and (5) store serum and tissues that may be used for later analysis.

To accomplish these objectives, 20 deer on the CVNRA have been killed, 10 deer in 1997 (Dunbar and Velarde, 1997) and 10 deer in 1998, by cervical or head gunshot with a .243 caliber rifle. Blood was immediately collected from the heart for later analysis. Deer were transported to a facility at the CVNRA where they were necropsied within 8-12 hours postmortem. Various tissues and feces were collected for assessment by histology, microbiology, virology, parasitology and nutrition indices using standard procedures and techniques.

RESULTS

The sample size of 10 deer collected for each year is adequate for estimating the health status of the entire herd. This sample size was based on the results of over 30 years of herd health evaluations conducted by the Southeastern Cooperative Wildlife Disease Study (SCWDS) throughout the southeastern United States (SCWDS, unpub. data); also, useful comparisons can be made between years and to other deer populations. Over time, assumptions can be made about the general trend of the population.

Upon necropsy, general body condition was assessed and the animals were sexed, aged, and weighed (Table 1).

Table 1. Body condition, sex, age, weight, and location of white-tailed deer collected on Cuyahoga Valley National Recreation Area, Ohio, March 3rd and 4th, 1998.

ID #	Sex	Age (yrs)	Location	Body Fat (%)[1]	Body KFI[2]	Weight (lbs)	Pregnant
002	F	7.5	Cuyahoga	38	III	120	Yes
003	F	4.5	Cuyahoga	60	IV	165	Yes
004	F	6.5	Cuyahoga	44	III	140	Yes
005	F	6.5	Cuyahoga	51	IV	130	Yes
006	M	0.75	Cuyahoga	6	I	85	-
007	F	2.5	Cuyahoga	30	III	110	Yes
008	F	0.75	Cuyahoga	9	I	80	No
009	F	8.5	Cuyahoga	46	III	140	Yes
010	F	4.5	Cuyahoga	39	III	115	Yes
011	F	2.5	Cuyahoga	33	III	130	Yes

[1]Techniques developed by T.P. Kistner (Oregon State University, Corvallis), 1980, A Field Guide Technique for Evaluating Physical Condition in Deer, based on visual estimation of the relative amounts of fat in six body locations and the condition of the body musculature.
[2]KFI=Kidney Fat Index is based on visual observation and estimation of the surface area of the kidney covered by fat I(<25%), II (25-50%), III (50-75%), IV (>75%).

General Body Condition

Mean body weight (BW) of the two fawns examined was 82.5 lbs. (37.5 kg) which is lower than the mean weight recorded from 2 fawns in February of 1997 (95 lbs.). Mean BW of 2.5 year-old and older females (n=8) was 131.25 lbs. (59.7 kg.) (Range, 110-165 lbs.) which is lower than the mean BW recorded from 7 females in February of 1997 (135 lbs.), but not statistically significant. Mean body fat % (BF%) and kidney fat index (KFI) for 1998 were 35.6% and 2.8 compared to 1997 BF% and KFI of 27.1% and 2.4 respectively.

Sex and Age

Mean age of adult females examined (n=8) was 5.4 years (range 2.5-8.5) and the fawns (n=2) were both 9 months old. The age structure of the population is not possible to determine due to the small sample size and bias of collectors. Sex ratio of fetuses (n=13) at near mid-gestation was 54% female and 46% male. No abnormalities were noted in the sex ratio and age structure information from the CVNRA herd.

Reproduction

Table 2 depicts the reproductive performance of deer on the CVNRA. Reproductive performance of the CVNRA deer herd in 1997-98 is considered low based on the number of fetuses per doe and the lack of pregnancy in the female fawn. Of the 8 does of breeding age (2.5-8.5 years old) examined, the percentage of does pregnant was 100% but the number of fetuses per doe was only 1.63. This is below the mean for deer in the same age group recorded for northern Ohio of 1.92 (Halls, 1984) but is greater than the value reported last year (1.3). The female fawn examined was not pregnant and there is an expected 60% pregnancy rate of fawns in northern Ohio. While data from a sample size of one is impossible to interpret, the two female fawns examined last year also were not pregnant. While the fetal size (crown-rump length) varied significantly from 1.0-19.0 cm in 1997 indicating a breeding season from about November 1 to January 1, the fetal size in 1998 was tightly clumped, ranging from 22-28 cm indicating a more concentrated breeding season and possibly a higher plane of nutrition than that observed in 1997. The twinning rate was 62.5% which was increased from last year's rate of 28%. Two does examined were 2.5 years old and had 1.5 fetus per doe. This value is increased from the 1997 value of 1.0. In general, reproductive performance of the deer herd of the CVNRA appears improved when compared to last year but is still low when compared to data from Northern Ohio and it is suspected that a low to moderate quality nutritional plane may be the most significant causal factor.

Table 2. Reproductive performance of white-tailed deer on the Cuyahoga Valley National Recreation Area, Ohio, March 3rd and 4th, 1998.

ID #	Age (yr)	Fetuses per Doe	Fetal Sex/Size[1] (cm)
002	7.5	2	F/25.5, F/26.0
003	4.5	2	F/25.5, F/27.0
004	6.5	2	M/21.5, F/22.0
005	6.5	2	M/24.0, M/24.0
007	2.5	2	M/23.0, M/25.5
008	0.75	0	
009	8.5	1	F/28.0
010	4.5	1	F/25.5
011	2.5	1	M/29.0

[1]Crown to rump length

Pathology

Observations of pathology from gross and microscopic examination of the 10 deer were predominantly unremarkable. Exceptions include two fawns that were extremely thin and one adult female (010) which had atrophy of the left thoracic limb musculature, pleuritis of the left thoracic wall and a 2 inch perforation in the left dorsal lung lobe consistent with past trauma. In another adult female deer (008), 1/4 of the right caudal lung lobe appear firm and white to gray in color. Histology of this section of the lung revealed mild multifocal granulomatous verminous pneumonia associated with low numbers of embryonated and nonembryonated parasite eggs. The lesions in deer 008 and 010 were probably significant debilitating conditions contributing to the relatively poor health in these individuals. Minor lesions on the surface of the livers of six of the deer indicated larval parasite migration. No meningeal nematodes (Parelaphostrongylus tenuis) or liver flukes (Fascioloides magna) were observed on gross examination of the brain and liver, respectively. One adult female (004) had small, firm white nodules in the caudal lung lobes consistent with lungworm migration. One adult female (007) had 0.2 cm firm white nodules in the heart near the aortic valves. The histology of this section revealed three sarcocysts lying within the muscle fibers of the heart.

Parasitology

No significant external parasitism was observed. Table 3 depicts the prevalence and intensity of parasites from fecal and blood analysis of the 10 deer. For all fecal based tests 1 gm pellets were weighed and samples were examined. None of the samples submitted had unusual or high numbers of eggs or larvae. The larvae found in the fecal samples were Parelaphostrongylus sp. It is not possible to distinguish P. tenuis (meningeal worm) from P. andersoni (muscle worm) and other species within this genus based on stage 1 larvae. Compared to the findings submitted in 1997, the 1998 deer had fewer parasite eggs and larvae. No parasites were seen on the blood smears examined. Neither the parasite prevalences nor species found are unusual nor considered a health issue.

Table 3. Prevalence and intensity of parasites from fecal and blood analysis from white-tailed deer collected on Cuyahoga Valley National Recreation Area, Ohio, March 3rd and 4th, 1998.

ID #	Strongyle # Eggs[1]	P. sp.[2] Larvae (stage 1)	Coccidia (Eimeria sp.)[1]	Capillaria # Eggs[1]	Blood Smear[3]
2	1	1	1		nps
3	1				nps
4	5				nps
5	8				nps
6	15	3		1	nps
7	2				nps
8	50				nps
9	3				nps
10	2				nps
11	22				nps

[1]Sheather's floatation technique- eggs per approximate gram of feces
[2]Parelaphostrongylus
[3]nps= no parasites seen

Serology

Serum from each of the 10 deer was analyzed for antibody titers to five disease pathogens; bluetongue virus (BTV), epizootic hemorrhagic disease (EHD), bovine viral diarrhea (BVD), parainfluenza virus type 3 (PI-3) and, Leptospira interrogans (5 serotypes). Results are shown in Table 4. In 1997 there was evidence of exposure to parainfluenza-3 virus in about half of the animals tested. In 1998, the prevalence of disease due to infectious pathogens appears to be low in the Cuyahoga deer herd as exposure was noted in only one of the animals tested. Deer 002 from the 1998 study had a PI-3 titer of 1:32 compared to PI-3 titers from 1997 that ranged from 1:8 to 1:32.

Table 4. Results of serologic tests used to detect antibodies against selected disease agents in white-tailed deer collected on Cuyahoga Valley National Recreation Area, Ohio, March 3rd and 4th, 1998.

Agent	No. Samples	Test	Reciprocal Titer
Bluetongue	10	competitive ELISA	negative
Epizootic Hemorrhagic Disease	10	agar gel immunodiffusion	negative
Bovine Viral Diarrhea	10	serum neutralization	negative
Leptospira canicola	10	micro agglutination	negative
L. grippotyphosa	10	micro agglutination	negative
L. hardjo	10	micro agglutination	negative
L. icterohemorrhagiae	10	micro agglutination	negative
L. pomona	10	micro agglutination	negative
Parainfluenza-3	10	serum neutralization	(002) 1:32

Clinical Pathology

Basic statistical descriptions of hematological and biochemical variables for 10 animals, 8 adult females, 2 nine month old fawns are presented in Tables 5 and 6. Data were compared with reference values provided by Seal et al. (1981), Bubenik and Brownlee (1987) and Tumbleson et al. (1968) for white-tailed deer when possible, otherwise reference values for domestic animals were used (Smith, 1996).

Hematology

None of the animals sampled were anemic, however anemia induced by undernutrition during winter may be concealed by the hemoconcentration that accompanies seasonal dehydration and decreased plasma volume (DelGiudice et al., 1992). Deer species have a large muscular spleen that can undergo splenic contraction and transitory increases in packed cell volume secondary to acute stressful events or blood loss. Pre-mortality stress may mask any anemic states in the animals sampled. The hemoglobin concentrations were consistently low as compared to reference values from killed white-tailed deer.

The leukocyte values are within the reference range with the exception of the two fawns which had a leukocytosis caused by a lymphocytosis. The observed lymphocytosis may be a function of age since the thymus is more active in young animals than adults. The lymphocyte counts in a majority of the animals sampled was elevated slightly without causing a leukocytosis which may indicate an immune response to an environmental stimulant. One hundred percent of the animals sampled have a neutropenia with 50% exhibiting a monocytosis. This may indicate a recent immune response causing an increased neutrophil consumption with chronic antigenic stimulation accounting for the high monocyte count. Ninety percent of the deer examined exhibited a marked eosinophilia. High eosinophil counts are rare in ruminants but may be a response to parasite infection. However, parasite burdens appeared low in the animals examined making parasite infection seem less likely as the cause for the eosinophilia.

Table 5. Mean (S.D.), minimum and maximum values for hematologic parameters of 10 free-ranging white-tailed deer from Cuyahoga Valley National Recreation Area, Ohio, March 3rd and 4th, 1998.

Parameter	Mean (S.D)	Min.-Max.	Reference Values[1]
PCV (%)	45.03 (4.3)	37.2 - 50.5	39 - 58
Hemoglobin (g/dl)	16.7 (1.1)	14.9 - 18.6	18.3 -19.3
MCHC (g/dl)	37.2 (3.1)	32.6 - 42.5	34.7 - 36.1
MCV (fl)	35.7 (1.2)	34.1 - 37.5	23.8 - 33.0
Nucleated RBC (/100 WBC)	.1 (.3)	0 -1	
Leucocytes ($x10^3/\mu l$)	2.1 (1.1)	1.2 - 4.4	1 - 4.2
Seg. Neutrophils (%)	26.6 (11.1)	10 - 41	57 - 72[2]
Seg. Neutr. ($x\ 10^3/\mu l$)	0.57 (.4)	0.12-1.52	0.6 - 2.8
Neutrophilic Bands (%)	0 (0)	0	
Neutr. Bands ($x10^3/\mu l$)	0 (0)	0	
Lymphocytes (%)	51 (15.5)	32 - 74	24 - 35[2]
Lymphocytes ($x10^3/\mu l$)	1.1 (.80)	0.436 - 3.212	0.6-1.8
Monocytes (%)	4.7 (3.9)	0 - 14	1 - 3[2]
Monocytes ($x10^3/\mu l$)	.09 (.05)	0 - .169	< 0.010
Eosinophils (%)	16.9 (8.6)	3 - 25	2 - 7[2]
Eosinophils ($x10^3/\mu l$)	.33 (.25)	0.18-0.352	< 0.10
Platelet Estimate	Adequate		

[1]Reference values were adopted from Seal et al., 1981 except when other source is indicated.
[2]Bubenik and Brownlee, 1987.

Biochemistry

Postmortem collection of samples from the heart may yield the high levels observed for potassium, AST and CPK in the deer sampled (Seal et al., 1981; White and Cook, 1974). High potassium levels may also result from in vitro hemolysis (Smith, 1996). Two samples, number 003 and 004, were hemolyzed and have the highest potassium values. Prolonged storage can similarly cause an increase in potassium but the serum was separated within 3 hours of collection. High concentrations of CPK and AST were also attributed to general trauma and tissue damage caused by the shooting. Hyperkalemia and high creatinine levels were observed in a study by DelGiudice et al. (1992) in early and late winter as a result of decreased plasma volume and glomerular filtration rate due to reduce water intake.

Slightly low chloride levels were apparent in 30% of the animals examined, a change likely due to dehydration. The calcium phosphorus ratio is well balanced but the magnesium values of the deer examined in 1998 are lower than those examined in 1997. Low magnesium is known to cause restlessness, muscle twitching, excitement and staggering in domestic cattle (Kaneko, 1989). Seasonal decreases in magnesium are associated with poor feed quality, and cold, wet and windy periods causing an increased body heat loss. Prolonged low levels of magnesium may lead to decreased conception rates (Kaneko, 1989). The low magnesium levels may be adversely affecting the reproductive rates and the general health status of the herd.

The validity of serum glucose for evaluating nutritional status is questionable as excessive depletion of gluconeogenic precursors can be masked by abnormally high glucose due to handling stress, or as in this case, the effects of gunshot trauma (DelGiudice et al., 1987). The glucose values do not fall below the normal limits and the high values may be explained by capture stress indicating that glucose is likely within normal range in a non-stressed state.

Hypoalbuminemia (<2.5 g/dl) was detected in two of the does (007 and 009) and in both of the fawns (006 and 008) which manifests an inadequate diet of protein (Smith, 1996). In 1997, low protein concentrations and BUN values in the normal range suggested energy deprivation and catabolism of body protein for energy (DelGiudice and Seal, 1988). In 1998, the total protein and BUN values are within the normal range indicating a better plane of nutrition and energy balance. A Student T-test was performed to compare the BUNs and the 1998 value was significantly higher than the 1997 ($P<.005$).

A hypothyroid state in the winter is normal for white-tailed deer, but can be intensified by decreased food intake (Seal et al., 1972). The adaptive significance of diminished thyroid function in malnourished deer may be to reduce energy requirements when caloric intake is inadequate; a vital consideration in over winter survival and neonatal mortality. The T4 values for 1998 (72.7 ng/ml) are lower than the values in 1997 (85.6 ng/ml). The T3 values in 1998 (0.93 ng/ml) are slightly higher than last year's value (0.6 ng/ml) but remain below the reference values. The decreased T4 and T3 concentrations may reflect the diminished dietary energy available. The mean serum T4 concentration in these deer was lower than values for undernourished female white-tailed deer (T4=97 ng/ml) (DelGiudice et al., 1987) suggesting a compromised nutritional situation.

Table 6. Mean (S.D.), minimum and maximum values for serum biochemical values for 10 free-ranging white-tailed deer from Cuyahoga Valley National Recreation Area, Ohio, March 3rd and 4th, 1998.

Parameter	Mean (S.D.)	Min.-Max.	Reference Value[1]
Sodium (mmol/L)	141.8 (6.4)	131 - 157	132 - 156
Potassium (mmol/L)	8.8 (2.3)	6 - 13.8	3.4 - 5.0
Chloride (mmol/L)	105.3 (6.9)	95 - 114	100 - 110
Calcium (mg/dl)	9.4 (.8)	8.8 - 10.6	8.1 - 10.8
Phosphorus (mg/dl)	8.0 (1.3)	7.2 - 11.3	4.5 - 8.5
Magnesium (mg/dl)	2.0 (.35)	1.6 - 2.9	2.2-2.6[3]
Glucose (mg/dl)	214.2 (129.3)	61 - 499	60 - 320
BUN (mg/dl)	27.8 (5.4)	21 - 36	15 - 45
Creatinine (mg/dl)	2.1 (.51)	1.5 - 3.2	0.4 - 2
Total Protein (g/dl)	6.3 (.61)	5.2 - 7	5.0 - 7.8
Albumin (g/dl)	2.4 (.22)	1.9 - 2.6	2.5 - 4.2
ALKP (U/L)	41.9 (28.3)	19 - 96	27 - 107[2]
CPK (U/L)	31078.8 (89828.8)	139 - 286150	20 - 400
AST (U/L)	1932.6 (5608.43)	72 - 17885	40 - 150
GGT (U/L)	55.8 (8.4)	41 - 70	40 - 100
Total Bilirubin (mg/dl)	.27 (.13)	0.1-0.5	0.1- 1
T3 (ng/ml)	.93 (.22)	0.43-1.3	1.25 - 3.05
T4 (ng/ml)	72.7 (19.3)	46 - 107	150 - 300

[1]Reference values were adopted from Seal et al., 1981 except when other source is indicated.
[2]Smith, 1996 (bovine values).
[3]Tumbleson et al., 1968.

Nutrition

Trace mineral and vitamin E

Basic statistical descriptions for serum copper, zinc and iron, and whole blood selenium and serum vitamin E concentrations are presented in Table 7.

Marginal levels of copper (.130 - .581) were present in 100% of the animals tested, based on data from domestic animals (Smith, 1996). In sheep, cattle and red deer, copper concentrations below 0.5 ppm are considered diagnostic for copper deficiency (Mertz, 1987; MacKintosh et al., 1986). In cattle, no clinical signs are observed until levels are <0.2 ppm, but animals with serum copper levels < 0.4 ppm show positive growth response to supplementation (Wikse et al., 1992). No clinical indications such as bleaching of the hair coat, abnormal hair quality, abnormal antler growth or anemia were observed. The values in 1998 are lower than values obtained from deer in 1997 which may indicate a downward trend and possible clinical manifestations in animals in the future.

Slightly low levels of zinc are noted in 90% of the animals tested as compared to data from 1997 where none of the animals examined had low levels of zinc. Zinc deficiency is characterized in calves by poor growth, rough scaly skin and dull listless appearance (Swenson, 1982). No clinical signs were noted in the deer examined, however they may become apparent in the future.

Based on whole blood data, selenium dietary intake was low in 4 out of 10 animals examined. Selenium deficiency primarily affects juveniles, resulting in increased mortality during neonatal and pre-weaning period (Keen and Graham, 1989) and may also cause low fertility (Robbins, 1983). Ohio is included in the area where selenium concentration in plants is low (80% of all forage and grain contain <0.05 ppm of selenium) relative to domestic animal needs (Robbins, 1983). No clinical signs were apparent likely because the vitamin E levels were only slightly below normal values. Adequate dietary levels of vitamin E can reduce the selenium requirement (Ullrey, 1981).

Two fecal indicies, 2,6-diaminopimelic acid (FDAPA) and fecal nitrogen (FN) are sometimes used in western mule deer and black-tailed deer and other wild ungulates to assess diet quality. Fecal samples from 10 deer were pooled into one composite sample for analysis of FDAPA and FN. The composite data from 1998 was 0.510 mg/gm FDAPA and 2.63% FN. Results for FDAPA and FN from 1997 were 0.614 mg/gm and 2.83% respectively. These results show a slight decline in winter nutrition between 1997 and 1998. This decline may in part be attributable to the later sampling date for 1998 (March 3) versus 1997 (February 3) and the resulting decrease in forage quality.

Table 7. Mean (S.D.), minimum and maximum values for selected trace minerals and vitamin A for 10 free-ranging combined adult female (n=8) and young of the year (n=2) white-tailed deer from Cuyahoga Valley National Recreation Area, Ohio, March 3rd and 4th, 1998.

Parameter	n	Mean (S.D.)	Min.-Max.	Reference Values[1]
Copper (ppm)	10	.452 (.13)	.130 - .581	0.7 - 1.2
Zinc (ppm)	10	.543 (19)	.381 - 1.02	0.7 - 1.0
Iron (ppm)	10	1.838 (.24)	1.32 - 2.11	0.7 - 2.3
Selenium (ng/ml)	10	112 (34.74)	60 - 151	100 - 180[2]
Vitamin E (μg/ml)	10	1.96 (.47)	1.19 - 2.92	2.09 - 3.05[3]

[1]Smith, 1996.
[2]Puls, 1994
[3]Ullrey, 1981

CONCLUSIONS

The general body condition for deer examined in 1998 was better than those animals tested in 1997. Increases in mean % body fat and mean KFI were seen in 1998. However, the mean body weight for adult does was slightly less than 1997 results. Reproductive indices also improved in 1998. The number of fetuses per doe increased from 1997 levels as did the twinning rate. T3 levels increased while T4 levels were slightly lower, and both DAPA and FN values were lower than 1997 levels.

Increases in fat indices, fetal rate and twinning rate reveal that the physical condition of the deer has improved from 1997 levels. However, these results are still below reference values for deer with adequate nutrition and continue to indicate that the deer population on the CVNRA is in excess of the carrying capacity of the habitat.

Recommendations for Research

Baseline data on deer herd health is essential in understanding current herd status and trends. With such information, predictions on population dynamics and responses to resource management actions can be made. It is recommended that (1) an annual herd health assessment, similar to the one conducted in 1997 and 1998, be conducted for an additional three years. After completion of a 5-year data base, assessments at three year intervals should be sufficient, (2) predictive models should be completed based on data from the health assessments and available information on population density, trends, production, recruitment, and mortality, (3) if resource management is initiated, annual herd health assessments should continue for a period to measure the degree of success of management.

Armed with this information resource management personnel of the Cuyahoga Valley national Recreation Area should be able to make scientifically based and sound decisions to properly manage the white-tailed deer herd and associated natural resources.

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