

PHYSICAL CHARACTERISTICS OF FIRE ISLAND'S DEER POPULATION AND AN
EVALUATION OF SPORT HUNTING WITHIN FIRE ISLAND NATIONAL SEASHORE

(OF DEER)
BY

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SUMMARY

White-tailed deer (Odocoileus virginianus) on Fire Island, NY were collected using sport hunters to assess the physical condition of the deer population while evaluating the utility of shotgun and archery hunting as tools for management. We collected tissue and blood samples from hunter-killed deer and participants filled out questionnaires detailing their activities and experience.

Fawns were in poor physical condition as evidenced by a variety of physiological indices. Low weights (males $x = 47.8$, females $x = 49.9$ coupled with high serum urea nitrogen levels (> 20 mg/dl) indicated a moderately advanced level of undernutrition for fawns examined in early winter.

Poor reproductive performance and the common utilization of Pinus by deer as a food source (93% of all deer sampled, $n = 61$) further suggest a population experiencing physiological stress and elevated competition for food. Significant dietary differences ($p = 0.007$) were observed between deer within Fire Island's Wilderness Area and deer residing adjacent to or among island communities. Given that deer on Fire Island exhibit relatively small home ranges and usually do not travel great distances (O'Connell and Sayre 1989), we attributed this difference to a more diverse flora and food availability on the western half of Fire Island due to non-native plantings by residents.

Most deer (79%) on Fire Island continue to be exposed to the Lyme disease spirochete (Borrelia burgdorferi) and the northern deer tick (Ixodes dammini) is a common external parasite on deer.

Sport hunting was met with intense opposition by animal rights activists and many community residents. The cost of this hunt doubled (\$60,000) due to increased expenses to insure public safety and compliance with state and federal regulations. Hunter densities for individual zones ranged between 5 and 19 hunters/km² for shotgun hunters and 15 and 38 hunters/km² for archers. Shotgun hunters were more efficient in collecting deer than archers (25% to 11%) but took an average of seven shots for each deer collected compared to 0.2 shots for archers. On the other hand, it took archers three times as long to collect a deer as it did hunters using shotguns. High deer densities on Fire Island and the number of slugs fired suggest that shotgun hunters were not sensitive to safety.

Many hunters felt that the hunt was harder than they expected mainly due to difficult terrain. Based on the daily collection of deer, we did not find any evidence of decreasing hunt efficiency as the hunt progressed. Although hunters were told to shoot the first deer possible, some failed to comply which resulted in a smaller sample of deer being collected.

Difficulties in hunting due to dense thicket vegetation, formidable logistics to access certain areas on FI, program expense to insure highly qualified, safety-conscious hunters,

proximity of some NPS areas to human habitation, unwillingness of some hunters to disregard deer sex and size in collecting deer, and the negative opposition to hunting on NPS lands combine to make recreational hunting of deer on Fire Island inefficient for either collecting biological information or reducing deer numbers.

If the National Park Service determines that providing another form of recreation on Fire Island is important, hunting can then be useful in accomplishing other objectives. However, considering the cost of \$500/deer incurred during this hunt (cost determined without added law enforcement expenses) we recommend that the National Park Service and the New York State Department of Environmental Conservation explore other alternatives for white-tailed deer management on Fire Island.

INTRODUCTION

Continuing urbanization and habitat fragmentation have resulted in an increase in non-traditional interactions between wildlife and human society (Litwin et al. 1985). The white-tailed deer (Odocoileus virginianus), in particular, has been propelled to the forefront of this problem by expanding its populations into many suburban and urban areas of the eastern United States (Flyger et al. 1983). This has been due to widespread changes in land use practices and active wildlife management programs (Porter 1991). Current landscapes characterized by a mosaic of forests, old fields, agriculture, parks and preserves, and suburban conditions provide a diverse array of habitats (Warren 1991). Deer are adaptable animals that thrive in these environments.

Deer have a long history in the American psyche. Almost decimated through greedy harvest by early American settlers, white-tails rebounded through intensive state management programs using regulated hunting. The return of the white-tailed deer is considered a triumph for modern American wildlife management (Downing 1987). Deer have been portrayed in the Walt Disney cartoon "Bambi" (1942) as defenseless, timid animals which for many, has produced "unrealistic beliefs, attitudes, and values" (Langenau et. al 1984, see Kellert 1976). Compounding this issue is that the animal rights and animal welfare movements have assailed hunting as a wildlife management activity for years (Schmidt 1989). In fact, the animal rights movement has focused

much of its attention on recreational hunting since the mid 1970's (Decker and Brown 1987). Because white-tailed deer is the most sought after big game species in this country, white-tailed deer hunting is often in the midst of the hunting controversy.

Continuing development has made our parks, refuges, and open space increasingly fragile and valuable. How the resources on these lands are managed comes under intense scrutiny. Land managers and public officials are left with the unenviable task(s) of protecting and conserving these resources amidst the pressures of interest groups, various government agencies and their own mandates. This scenario has become common on lands owned by the National Park Service (NPS). In the last decade, NPS concerns over increasing deer populations, deer-vegetation relationships and possible impacts to other park resources have resulted in the funding of 20+ research studies to examine these issues (Soukup et al. 1990).

One NPS unit that became involved in deer research in the 1980's was the Fire Island National Seashore (FINS) on Long Island, NY. In response to several concerns regarding management of Fire Island's (FI) deer population in the early 1980's, the NPS funded a project to evaluate the deer population within the barrier island ecosystem (O'Connell and Sayre 1989). That study established a data base estimating deer population size, movement patterns and home range, physical condition, food habits, and the status of Lyme disease relative to the deer population.

Additional work began during the mid-1980's to examine the effects of deer on island vegetation (Art 1987).

As the 1980's ended FI residents were concerned that the deer population was increasing, particularly among the communities. Community leaders consulted with the New York Department of Environmental Conservation (DEC) about possible deer management alternatives in late fall of 1989. Further consultations with NPS management resulted in a decision to collect biological samples (to increase the amount of data available on the deer population) using sport hunters. In cooperation with DEC the NPS allowed sport hunters to collect deer on FINS property during a two week period in December 1988 and January 1989. Special archery and shotgun seasons were established for FI under NY State law.

Our objectives were to evaluate the physical condition of FI deer and the utility of sport hunting as a possible management tool for FI's deer population.

STUDY AREA

FI is a 50 km long barrier island located off Long Island's south shore separated from the mainland by Great South Bay (Figure 1). It is part of a string of barrier islands extending

Figure 1. Location of Fire Island, NY.

from NY City on the west to Montauk Point on Long Island's east end. FI encompasses three different parks involving the county, state, and federal governments which also includes a federal wilderness area, U.S. Coast Guard installation, and residential communities. The NPS is the major land owner on FI and FINS includes more than 50% of the island's land area.

FI vegetation and topography is typical of north Atlantic coastal barrier islands. The island's flora was recently inventoried (Stalter et al. 1986) and a detailed description of the major vegetation communities is provided by Art (1976).

METHODS

Biological Sampling and Analyses

For future comparative purposes and further utility by NPS personnel, samples and collection techniques used during this study were identical, unless specified otherwise, to techniques employed by O'Connell and Sayre (1989). Methodologies and appropriate references are detailed in that report.

Hunters were instructed to disregard deer sex and age and collect the first deer possible. Deer were to be immediately returned to a check station located on FI where they were examined and samples collected. Rumens, kidneys and associated renal fat, femurs, lower jaw, female reproductive tracts, and

blood samples were collected and whole and dressed weights were recorded. Blood serum was analyzed for a variety of serum chemistries and reactivity to the Lyme disease spirochete, Borrelia burgdorferi. An Enzyme Linked Immunosorbent Assay (ELISA) was used for the Lyme disease analysis.

After samples were collected deer were returned to the hunter. DEC biologists recorded deer ages based on the wear technique (Severinghaus 1949). We collected incisors from deer jaws and ages were determined by the cementum annuli technique (Gilbert 1966). Although not part of this study, medical research scientists from Montifiore Medical Center in NY City collected pancreas samples from several deer to be used in an ongoing cancer research program.

FINS property was divided into several zones to collect deer from different areas on FI as well to evaluate the ability of deer hunters to function in different habitats. Figure 2 delineates the six zones (listed by letter) on FI in which hunting was allowed during this study.

Comparisons were made between deer collected in zones B and C to deer within the other four zones (F, G, H, and I). We based this decision on differences in topography, vegetation, and land use found along FI. Vegetation and topography within the Wilderness Area (zones B and C) (and in general on the eastern

Figure 2. Map of Fire Island, NY showing location of zones where sport hunting of deer was allowed during 1988-89 special season.

half of FI) are characterized by large grassy swale areas, pockets of pine savannas with some thicket vegetation, and extensive salt marshes. Thicket vegetation is more extensive in both the middle and western portions of the island and there are no extensive salt marshes on the western half of FI.

Furthermore, deer diets within zones F, G, H, and I are associated with FI's residential communities. Residents feed deer in the communities and there are a variety of non-native horticultural plants in residential gardens.

The number of deer used to calculate statistics varied. Generally, we attempted to compare deer collected from within FI's Wilderness Area to deer from the more western areas on FI based on the reasons discussed previously. However, deer were brought to the check station in varying condition and in some zones very few deer were collected. As a result, samples were not always available or were very small which precluded some statistical analyses. For example, adult and yearling deer were combined as one group for a comparison of physiological parameters and diets between the east and west areas of FI.

Student's t-tests were used to compare means for individual physical parameters and blood characters. We compared diets using a multivariate analysis of variance with repeated measures (Timm 1975). Raw percent data were normalized using an arcsine transformation and each rumen represented a repeated measure. Differences for all tests were considered significant at $p \leq 0.05$.

Plant identification in rumen samples was generally made to the genus level but was not possible for all items (e.g., grass, ferns). All samples were referenced against an herbarium collection from FINS. Differences in deer diets along FI were based on 9 categories: shrubs, conifers, graminoids, seeds/pods/nuts, forbs, ferns, lichens/mushrooms, berries, and insects.

Hunting

Because hunting took place only on FINS property and the state sets deer hunting seasons as well as the type of weapon allowed, selection of six zones conformed to a variety of state and federal regulations. Safety, ease of administration, and experimental variables (see previous section) were all evaluated to select hunting areas. Safety regulations (e.g., no weapon discharge around buildings) during the hunt complied with or exceeded NY State legal requirements. All participating hunters were licensed by the State of NY. A variety of hunt-related statistics were calculated (e.g., hunter success, number of shots taken/kill) to evaluate the hunt. Questionnaires developed by FINS personnel were provided to each hunter to compile information regarding the hunting experience (Appendices A and B). Interviews were also conducted with individual hunters to gain insight into the experience of hunting deer on a barrier island.

Each zone was allotted a maximum number of hunters each day. A total of no more than 100 deer were to be harvested from the entire island and limits on the number of deer were set for each zone. Hunting was terminated in a zone upon reaching that number.

RESULTS

Physical Condition of Deer

Although the original intention was to collect 100 deer, the operation was stopped when 60 animals were collected. Six deer were collected by archers and 54 by shotgun (Table 1)¹. Over half of all deer collected (42) were from within FI's Wilderness Area (zones B and C). Deer ages ranged from fawns to nine years old (Table 1). Seven of the eight age classes represented showed a higher number of females than males. The oldest animal was a doe while the oldest buck was seven years old. Fawns represented 30% (n = 18) and older animals ($\geq$ four years old) 18% (n = 11) of the entire sample.

Whole weights, kidney fat indices and femur marrow fat generally increased with deer age (Table 2). Serum nitrogen levels (SUN) were higher for fawns than either yearlings or adults (Table 3, 4, and 5). Only femur marrow fat yielded a significant difference between deer from the FI Wilderness and

¹Due to the large amount of tabular information contained herein, all tables are located at the end of the report to facilitate ease of reading.

deer near the residential communities $t = 2.047$, $p = 0.047$). Notably, only 50% (0.58) of adult females ($\geq$ two years old), 20% of the yearlings, and none of the fawns examined were pregnant (Table 6).

Thirty-six different plant genera were found in the rumens sampled as well as several other major groups (e.g., grass, ferns) (Table 7). A comparison of deer diets on FI (zones B and C versus F, G, and H) indicated that there was a significant area difference ($F = 0.007$; $df = 50, 8$; $p = 0.007$). However, no differences were found based on age ($F = 1.529$; $df = 50, 8$; $p = 0.171$, [adults and yearlings vs. fawns]) or age and area interactions ($F = 1.604$; $df = 50, 8$; $p = 0.148$).

All biological data are presented in Tables one through seven. Data are presented as mean values by sex and age.

Lyme Disease

Fifty-three blood samples were tested for reaction to the Lyme disease spirochete (Table 8). The mean optical density was 0.331 (SD = 0.218) with a high of 0.832 and a low of 0.049. Samples were considered having a positive reaction if the titer was 0.113 or higher. Thus, 79% of the deer sampled had developed antibodies to the Lyme disease spirochete.

Although collection of parasites was not part of the sampling protocol, cursory observations of deer carcasses revealed that northern deer ticks (Ixodes dammini) are common on deer all along the island.

Hunting

Two hundred and seventy two hunters registered to hunt on FI. Success rates were 24.6% for shotgun hunters and 11.3% for archers in collecting deer (Table 9). Archers needed three times as long afield to collect a deer as did hunters using shotguns. Each shotgun hunter took an average of seven shots for each deer collected while archers took an average of 0.2 shots. Zones in the middle of the island required more time hunting to collect an animal than either in the Wilderness (zones B and C) or near the FI Lighthouse (zone H). Success in collecting deer did not appear to decrease as the hunt progressed (Table 10).

A total of 4.18 km² (1022 acres) within the Park was hunted (breakdown provided by zone in Table 11). Hunter densities ranged from five shotgun hunters/km² to 38 archers/km² for individual zones.

DISCUSSION

Physical Condition of Deer and Lyme Disease

Weights, femur fat, kidney fat indices, and some blood chemistry levels indicated that fawns were in poor physical

condition and generally malnourished. In this condition and because samples were taken in the early winter it is unlikely that fawns we examined would have survived. SUN concentrations for fawns indicated moderately advanced undernutrition (Delgiudice and Seal 1988).

Porter (1991) lists the various characteristics of deer populations that have not been subjected to intensive management and have no natural predators (e.g., wolves [Canis lupus]). Some of these traits are evident in FI's deer population. While we do not know if fawn survival is declining, the poor condition of fawns examined suggests that mortality for this age group is high. Both pregnancy and ovulation rates show that reproductive performance is poor in all female age classes on FI. Pregnancy and ovulation rates reported in other regions support this observation. Pregnancy rates in the midwest (Harder 1980) and ovulation rates reported in Texas (Teer 1984) exceed rates found on FI. Finally, examination of Art's vegetation data for FI (1987) shows that certain plant species are declining. This provides additional evidence that deer are experiencing increased competition for food, altering their diets, and exhibiting physiological stress.

It is essential to recognize that while FI's deer population does not appear to be in prime physical condition it is not the intent of the NPS to insure native animal populations exhibit

certain physical characteristics. On the other hand, it is the goal of state wildlife programs to produce healthy animals whose numbers are within the capability of their environment to sustain them, insuring the continued resource use. Thus, when reviewing the biological data on deer from FI it is likely that interpretations will vary widely. One must remember that deer on FI have simply responded to their environment and have been subject to a different set of management objectives than most state managed populations.

The question of whether or not FI's deer population (and other deer populations on NPS lands) should be manipulated is beyond the scope of this report. The salient points of that issue have been reviewed in detail elsewhere (Underwood and Porter 1991, Warren 1991).

Hunting

Archery and shotgun are two commonly used and accepted methods of hunting deer. Use of sport hunters has been found to be an effective and economically efficient method in collecting deer (Palmer 1980, Ishmael and Rongstad 1984). Each area hunted, however, should be evaluated based on its physical features and the hunting method employed to determine a technique's usefulness for both a specific time and place.

Archery hunting appears to be considerably more difficult in the barrier island landscape than other environments. In this study archers took nearly three times as long as shotgun hunters to collect a deer yet yielded < 50% of the success rate (11% vs. 25%). While invoking many primitive traditions of hunting archery has been criticized as not being productive in terms of efficiently harvesting animal populations. Arrow placement is critical or a wounded animal results and tracking is long and tedious. A trained tracking dog was brought in on two occasions on FI in an attempt to retrieve wounded deer but was unsuccessful each time. Formal studies of archery wounding of deer have been conducted in Texas and have shown that 50% of all deer shot at with bow and arrow are wounded and not recovered (Boydston and Gore 1987). Additional work in this area has shown that bow hunters wound more antlered deer than represented in a living population (Stormer et al. 1979). It does not seem practical, if the objectives are to quickly gather as much information or to reduce deer numbers, to utilize archery as a management tool. Based on FI's results, archery as a hunting technique should probably be left only to areas whose primary goal is to provide a variety of hunting opportunities for sportsmen.

Shotgun hunting presented a different scenario. While shotgun hunting was generally more efficient than archery in collecting deer on FI, there were large differences in success

rates among individual zones. Shotgun hunting in the more western areas on FI took more hours afield than in either zones B or C to collect a deer. We associated these results with the relatively dense vegetation in the more western zones hunted.

Despite the greater efficiency of shotguns, an alarming point regarding the hunting operation on FI is that an average of seven shotgun slugs were fired for each deer collected. The DEC allows only shotgun hunting of deer on Long Island's mainland and in much of southern New York. This is due primarily to the fact that shotgun slugs do not travel long distances after being shot and are considered safer than rifles. Shotguns are often the only weapon allowed for deer hunting when adjacent to sizable human populations. The number of shots taken on FI exceeded any other reports we were able to find in the literature: two-four shots reported in Texas (Boydston and Gore 1987), 1.65 shots in Ontario (Holsworth 1973), or 4.7 shots in Illinois (Roseberry et al. 1969) for each deer collected. Considering the high deer densities on FI (O'Connell and Sayre 1989) and complaints of unsafe hunters by other hunters on FI, seven shots per deer suggests little sensitivity to safety.

Reviewing survey responses from participating hunters we discovered that many hunters found the hunt on FI harder than they expected. The shrubby, thicket-like vegetation that

characterizes FI makes for difficult sighting of deer. In addition, forested areas include poison ivy (Rhus radicans) and briar (Smilax spp.) thickets that some hunters were unwilling to confront. The scrubby nature of pitch pines (Pinus rigida) and American holly (Ilex opaca) trees do not lend themselves to tree stands. Hunters on the western half of FI (zones F, G, and H) had a more difficult time hunting than hunters working in zones B or C. We attributed this to dense vegetation, little open area in zones F, G, H, and I and having to travel a greater distance along the beach to these zones compared to hunters in the Wilderness area (zones B or C).

While the barrier island environment on FI presented some situations that hunters were not accustomed to, it should not be misinterpreted that hunting in the coastal environment is generally inappropriate or inefficient. Hunting programs have been operated on other barrier islands with success. For example, deer are hunted within Cape Cod National Seashore in Massachusetts and Assateague Island National Seashore in Virginia.

The Cary Arboretum in Millbrook, NY conducts an annual deer hunt (Winchcombe 1988). It is tightly controlled and each hunter must submit an application to hunt, pass a shooting test for accuracy and attend a session for an explanation of rules and guidelines. Failure to comply with a regulation results in the loss of a hunter's permit. This hunt has been recognized as an extremely efficient operation after which to model other hunts.

Because there were many operational issues (e.g., safety, area access) during the FI hunt that were of concern, we felt it relevant to point out at least one area that has efficiently dealt with numerous operational issues.

The cost of sport hunting on FI increased significantly due to public protests and the resulting additional law enforcement costs needed to insure safety and implementation of State and federal laws. As a result, this hunt is estimated to have cost approximately \$60,000. In Wisconsin, Ishmael and Rongstad (1984) estimated the cost of each deer collected by shooting deer over bait to be \$74. costs on FI far exceeded this amount. Even at the lower cost of \$30,000, each deer collected on FI cost approximately \$500.

CONCLUSIONS

Examination of the biological data collected on deer from FI coupled with Art's (1987) vegetation work shows that the deer population is characteristic of an unhunted population with no natural predator (Porter 1991). The population is experiencing physiological stress as reflected by a variety of biological parameters. Dietary differences among deer from different areas on FI shows some variation in plant diversity along the island.

Intentional feedings and non-native plantings in and around FI's communities increases food availability and diversity and provides an artificial food source. It eliminates any semblance of a natural environment. In an area with many human inhabitants, non-native plantings and deliberate feedings are only inviting increased human-deer conflicts, already of concern to Park management on FI among the communities.

Shotgun hunting, while more efficient than archery in collecting deer on FI raises questions regarding safety when operating in small areas with high hunter densities. Other issues of concern include accessibility constraints, difficult hunting terrain, relatively small areas in close proximity to human habitation, opposition to hunting by local residents, and the high dollar cost per deer collected outweigh employing sport hunters to accomplish a goal related to either research or management. The usefulness of hunting on FI to either reduce deer numbers or to collect scientific data is not efficient either in terms of biological sampling or economics.

It is common in most national park units to prohibit hunting within the park's boundaries. Much of the American public believe that National Parks are not (and should not be) open to sport hunting; this idea has a long history dating back to the creation of the NPS. Negative opposition to sport hunting has also been documented in suburban areas by Decker and Gavin (1987). In that case hunting was not well received by residents

adjacent to the Seatuck National Wildlife Refuge on Long Island, NY, a short distance from FI. In fact, the authors recommended a non-traditional management approach to burgeoning deer populations. It is only logical, then to recommend that FINS management explore alternatives other than hunting for FI deer management, especially within the island's residential communities.

If the NPS is to embark on an effective deer management program on FI, public education within the residential communities is the requisite first step. While "public education" often appears as a benign component of deer management, the entire FI community (Park, residential communities, and other government agencies) would be well served to quickly and thoroughly address the issue. It is imperative that some outreach be made to the residential communities. For example, programs in the Sailors Haven complex (the Seashore put together an interpretive display on deer biology in the late 1980's) are well-intentioned but have little impact on community residents because they do not typically visit NPS sites. In fact, the NPS must take programs into the communities if they are to have any hope of communicating effective deer management information.

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GENERAL INSTRUCTIONS

Performance Awards:

For non-PMRS employees, a one-time cash award based on a percentage of base pay may be granted to employees who receive a rating of record of exceeds fully successful or above, i.e., Level 4 or 5. See 370 DM 430 and bureau procedures for specific guidance.

Employees under the Performance Management and Recognition System are paid performance awards under that system. See 370 DM 540, annual policy issuances, and bureau procedures for specific guidance.

Quality Step Increases:

For General Schedule employees, a quality step increase may be granted for employees who receive an outstanding (Level 5) rating of record. Only one quality step increase may be granted within a 52-week period. See 370 DM 531 and bureau procedures for specific guidance.

Special Act or Service Award for an Individual:

This is a cash award granted for a non-recurring special act or service. The award is based on tangible and/or intangible benefits. See 370 DM 451 and bureau procedures for specific guidance.

Special Act or Service Award for a Group:

This is a cash award which is divided among members of a group granted for a non-recurring special act or service. Justification should describe the overall mission accomplishment of the group as well as the contributions of each individual toward the overall mission accomplishment. The total award is based on tangible and/or intangible benefits derived from the group accomplishment. Individual awards may be divided equally or in proportion to individual contribution to the group effort. See 370 DM 451 and bureau procedures for specific guidance.

Table 1. Sex and age composition for deer collected by sport hunters during experimental shotgun hunt on Fire Island, January 1989^{a,b}.

AGE CLASS	B&C	HUNT ZONE			TOTAL
		F	G	H	
Fawn					
Male	8	1	-	-	9
Female	7	-	1	1	9
1					
Male	3	-	1	-	4
Female	3	1	1	-	5
2					
Male	4	1	-	-	5
Female	5	2	-	-	7
3					
Male	1	-	-	-	1
Female	2	-	1	-	3
4					
Male	1	-	-	-	1
Female	3	-	1	-	4
5					
Male	-	-	-	-	-
Female	-	-	-	-	-
6					
Male	-	-	-	-	-
Female	-	1	-	-	1
7					
Male	1	-	-	-	1
Female	1	-	-	-	1
8					
Male	-	-	-	-	-
Female	2	-	-	-	2
9					
Male	-	-	-	-	-
Female	1	-	-	-	1
	42	6	5	1	54

a: Tooth samples were not always available from a specimen.

b: Results are based on cementum analyses, conducted by Matson's Laboratory, Milltown, MT.

Table 2. Mean kidney fat percentages, femur marrow fat, and whole weights (in kg) of all Fire Island deer collected during December 1988 - January 1989 hunt.

<u>Age</u>	<u>Sex</u>	<u>n</u>	<u>Kidney Fat</u> x (SE)	<u>Femur Marrow</u> x (SE)	<u>Whole Weight</u> x (SE)
Fawn	Male	(10)	17.1 (5.1)	50.2 (7.1)	47.8 (2.0)
	Female	(9)	18.7 (5.0)	55.2 (5.9)	49.9 (3.4)
Yrling	Male	(4)	71.5 (16.7)	79.2 (2.9)	91.5 (7.5)
	Female	(5)	102.0 (17.6)	87.1 (2.3)	85.0 (9.2)
Adult	Male	(8)	63.3 (7.6)	92.0 (0.9)	116.8 (4.9)
	Female	(21)	103.6 (10.0)	91.0 (0.7)	105.5 (3.9)

Table 3. Mean values for blood chemistry of adult white-tailed deer sampled on Fire Island, December 1988 - January 1989.

Assay (units)	Blood Values			
	Males (n = 6)		Females (n = 14)	
	x	(SE)	x	(SE)
Serum Urea Nitrogen (mg/dl)	18.2	(2.6)	16.8	(1.5)
Creatinine (mg/dl)	2.1	(0.1)	2.2	(0.1)
SUN-Creatinine Ratio (mg/dl)	8.7	(1.3)	7.8	(0.7)
Sodium (meq/l)	153.8	(0.6)	149.1	(1.8)
Phosphate (mg/dl)	13.4	(1.3)	15.4	(1.3)
Calcium (meq/l)	11.3	(0.6)	11.3	(0.3)
Cholesterol (mg/dl)	62.0	(10.2)	55.9	(5.2)
Triglycerides (mg/dl)	134.3	(24.3)	226.9	(25.1)
Total Protein (g/dl)	6.2	(0.4)	6.3	(0.3)
Albumin (g/dl)	2.6	(0.1)	2.6	(0.1)
Globulin (g/dl)	3.6	(0.3)	3.7	(0.3)
Albumin-Globulin Ratio	0.7	(0.0)	0.7	(0.0)
Chloride (meq/l)	107.5	(11.1)	97.4	(1.9)
Total Bilirubin (mg/dl)	0.3	(0.1)	0.3	(0.0)
Potassium (meq/l)	15.5	(1.9)	20.2	(2.1)
Glucose (mg/dl)	123.3	(32.8)	119.7	(24.9)
AKP ^a (IU/l)	65.3	(15.9)	65.1	(12.3)
GGL ^a (IU/l)	36.8	(3.1)	40.1	(4.3)
LDH ^a (IU/l)	2509.8	(1338.8)	272.7	(235.5)
SGOT ^a (IU/l)	1298.0	(967.4)	459.6	(107.4)
SGOP ^a (IU/l)	154.8	(62.4)	85.8	(8.1)

a: AKP = alkaline phosphatase; GGL = glutamic pyruvic transaminase; LDH = lactic dehydrogenase; SGOT = glutamic oxaloacetic transaminase; SGOP = glutamic pyruvic transaminase.

Table 4. Mean values for blood chemistry of yearling white-tailed deer sampled on Fire Island, December 1988 - January 1989.

Assay (units)	Blood Values			
	Males (n = 7)		Females (n =)	
	x	(SE)	x	(SE)
Serum Urea Nitrogen (mg/dl)	19.5	(1.5)	16.7	(8.0)
Creatinine (mg/dl)	2.1	(0.1)	1.4	(0.4)
SUN-Creatinine Ratio (mg/dl)	9.6	(1.0)	14.2	(5.8)
Sodium (meq/l)	140.5	(3.5)	144.3	(5.6)
Phosphate(mg/dl)	16.0	(3.5)	12.8	(2.0)
Calcium (meq/l)	9.4	(0.4)	10.2	(0.1)
Cholesterol (mg/dl)	64.5	(3.5)	41.0	(2.7)
Triglycerides (mg/dl)	192.0	(17.0)	120.7	(49.1)
Total Protein (g/dl)	5.0	(0.5)	5.1	(0.4)
Albumin (g/dl)	2.2	(0.2)	2.2	(0.2)
Globulin (g/dl)	2.9	(0.4)	2.9	(0.3)
Albumin-Globulin Ratio	0.8	(0.1)	0.8	(0.1)
Chloride (meq/l)	94.5	(2.5)	100.0	(3.1)
Total Bilirubin (mg/dl)	0.3	(0.1)	0.4	(0.3)
Potassium (meq/l)	18.3	(2.8)	14.0	(4.1)
Glucose (mg/dl)	188.5	(107.5)	130.7	(68.0)
AKP ^a (IU/l)	56.5	(2.5)	74.3	(25.3)
GGL ^a (IU/l)	40.5	(14.5)	31.3	(2.0)
LDH ^a (IU/l)	610.0	(610.0)	833.0	(300.1)
SGOT ^a (IU/l)	475.0	(9.0)	293.0	(176.9)
SGOP ^a (IU/l)	80.5	(6.5)	70.7	(17.5)

a: AKP = alkaline phosphatase; GGL = glutamic pyruvic transaminase;
 LDH = lactic dehydrogenase; SGOT = glutamic oxaloacetic
 transaminase; SGOP = glutamic pyruvic transaminase;

Table 5. Mean values for blood chemistry of fawn white-tailed deer sampled on Fire Island December 1988 - January 1989.

Assay (units)	<u>Blood Values</u>			
	Males (n = 7)		Females (n = 7)	
	X	(SE)	X	(SE)
Serum Urea Nitrogen (mg/dl)	24.7	(2.2)	22.7	(2.7)
Creatinine (mg/dl)	1.7	(0.1)	1.6	(0.1)
SUN-Creatinine Ratio (mg/dl)	14.5	(1.3)	14.4	(1.8)
Sodium (meq/l)	153.0	(1.3)	148.3	(2.6)
Phosphate (mg/dl)	14.5	(2.1)	17.2	(2.3)
Calcium (meq/l)	9.9	(0.5)	10.9	(0.6)
Cholesterol (mg/dl)	53.9	(5.3)	65.9	(7.2)
Triglycerides (mg/dl)	104.1	(23.8)	189.9	(38.6)
Total Protein (g/dl)	4.7	(0.3)	5.5	(0.6)
Albumin (g/dl)	2.0	(0.1)	2.3	(0.2)
Globulin (g/dl)	2.7	(0.2)	3.2	(0.4)
Albumin-Globulin Ratio	0.8	(0.0)	0.7	(0.1)
Chloride (meq/l)	102.6	(2.8)	98.9	(2.7)
Total Bilirubin (mg/dl)	0.2	(0.0)	0.2	(0.0)
Potassium (meq/l)	11.7	(2.2)	20.3	(2.8)
Glucose (mg/dl)	79.9	(21.4)	183.6	(41.0)
AKP ^a (IU/l)	82.3	(20.9)	168.4	(40.6)
GGL ^a (IU/l)	39.4	(4.9)	59.6	(12.6)
LDH ^a (IU/l)	1109.1	(176.2)	1954.9	(564.6)
SGOT ^a (IU/l)	263.4	(33.3)	803.6	(310.1)
SGOP ^a (IU/l)	67.1	(3.4)	101.3	(16.9)

a: AKP = alkaline phosphatase; GGL = glutamic pyruvic transaminase;
 LDH = lactic dehydrogenase; SGOT = glutamic oxaloacetic
 transaminase; SGOP = glutamic pyruvic transaminase;

Table 6. Reproductive performance of female deer examined from Fire Island during December 1988 - January 1989.

<u>Age Class</u>	<u>Ovulation Rate^a</u>	<u>Percent Pregnant</u>
Fawns ^b (n = 9)	----	0.00
Yearlings (n = 5)	0.60	0.20
Adults (n = 20/19)	1.10	0.58
a: # of corpora lutea divided by the # of deer examined. b: Ovaries were not examined		

Table 7. Breakdown of plant components found in deer rumens collected from Fire Island during December 1988 January 1989^a.

Plant Species/Group	Mean % Occurrence (Number of samples in which item occurred; total n = 61)
Acer	0.14 (4)
Amelanchier	5.82 (47)
Arctostaphylos	2.21 (39)
Gaultheria	1.95 (19)
Heath family	2.79 (37)
Ilex	2.33 (31)
Kalmia	0.21 (5)
Ledum	0.27 (8)
Myrica	4.91 (50)
Parthenocissus	0.17 (4)
Populus	0.08 (4)
Prunus	4.27 (49)
Quercus	0.16 (2)
Rhododendron	1.20 (23)
Rhus	6.93 (52)
Ribes/Rubus	1.89 (26)
Rosa	3.33 (39)
Salix	0.19 (6)
Sassafras	1.24 (5)
Smilax	0.41 (12)
Toxicodendron	0.05 (1)
Unknown shrub leaf	1.77 (35)
Unknown shrub stem	3.32 (33)
Vaccinium	4.68 (46)
Vitis	0.38 (9)
TOTAL SHRUBS:	50.66 (61)
Conifer Bark	1.05 (7)
Juniperus	9.82 (44)
Pinus	27.26 (57)
Taxodium	0.03 (3)
TOTAL CONIFERS:	38.17 (60)
Carex	0.07 (2)
Grass	1.24 (20)
Juncus	0.51 (8)
Scirpus	0.19 (3)
TOTAL GRAMINOIDS:	2.00 (23)

Table 7: Cont.

TOTAL SEED/POD/NUT:	0.88	(11)
Artemesia	0.47	(8)
Cakile	0.18	(7)
Composite Family	0.03	(3)
Euphorbia	0.23	(8)
Hudsonia	0.10	(2)
Iva	2.03	(22)
Salsola	0.19	(5)
Solidago	0.18	(8)
Unknown forb	1.25	(20)
TOTAL FORBS:	4.65	(35)
TOTAL FERNS:	0.26	(15)
TOTAL LICHEN/MUSHROOM:	3.30	(34)
TOTAL BERRY:	0.03	(1)
TOTAL INSECT:	0.07	(2)

^a: Analysis and plant identification was conducted by the Wildlife Habitat Laboratory, Washington State University, Pullman, WA.

Table 8. ELISA results for B. burgdorferi for blood samples collected from Fire Island deer, December 1988 - January 1989.

ELISA Categories	# of Deer
0.000 - 0.999	9
0.100 - 0.199	7
0.200 - 0.299	10
0.300 - 0.399	12
0.400 - 0.499	5
0.500 - 0.599	2
0.600 - 0.699	3
0.700 - 0.799	2
0.800 - 0.899	3
0.900 - 1.000	-
Total # Deer Tested	53

Table 9. Hunter effort and success rates for Fire Island National Seashore hunting zones, 1988-1989.

Type of Hunt/Zone	Daily Hunter Quota	Total # Hunters	Deer Harvest	Total Hrs. Hunted	Hrs. Hunted/Deer Harvested
ARCHERY					
Sailors Haven(G)	8	25	2	249	124.5
Lighthouse(H)	6	26	4	262	65.5
Robbins Rest(I)	2	2	0	8	--
Totals	16	53	6	519	86.5
SHOTGUN					
Wilderness(B)	12	85	24	407	16.9
Wilderness(C)	10	80	21	711	33.8
Talisman(F)	6	41	7	305	43.6
Sailors Haven(G)	2	13	2	76	38.0
Totals	30	219	54	1499	27.7

Table 10. Daily deer harvest by zone during deer hunt on Fire Island National Seashore, December 1988 - January 1989.

Date	Zone B	Zone C	Zone F	Zone G	Zone H
ARCHERY					
12/17/88				1	0
12/18/88				1	1
12/21/88				2	0
12/22/88				0	1
12/23/88				0	0

Total				4	2
SHOTGUN					
01/09/89	7	1	1	0	
01/10/89	6	3	1	0	
01/11/89	5	3	2	0	
01/12/89	2	0	1	0	
01/13/89	0	1	2	1	
01/16/89	0	2	0	1	
01/17/89	4	5	0	0	
01/18/89	0	6	0	0	

Total	24	21	7	2	

ARCHERY TOTAL:	6 =			4	2
SHOTGUN TOTAL:	54 =	24	21	7	6
COMBINED TOTAL:	60				

Table 11. Number of acres hunted on Fire Island and the maximum number of hunters allowed in each zone for each hunting day.

<u>Zone</u>	<u>Area Hunted(km²)</u>	<u>Maximum # of Hunters</u>	<u># of Hunters/km²</u>
B	1.11	12	10.8
C	1.94	10	5.1
F	0.38	6	15.7
G	0.21	8 ^a /4 ^b	38.0/19.0
H	0.38	6	15.7
I	0.16	2	12.5
Total Acreage	4.18		
Shotgun Totals (B, C, F, G):	3.64	32	8.79
Archery Totals (G, H, I):	0.75	16	21.33

a: # of hunters allowed using bow and arrow

b: # of hunters allowed using shotguns

Appendix A. Sample questionnaire given to archery hunters participating in the Fire Island deer herd analysis and experimental sport hunt, December 1988 - January 1989.

DEER QUESTIONNAIRE

1. Date _____
 2. Zone _____
 3. Time in the field _____ A.M. to _____
 4. Total number of hours _____
 5. Number of deer seen _____
 6. Number of Bucks _____ Does _____ Fawns _____
 7. Number of shots fires _____
 8. Number of deer hit _____
 9. Number of deer recovered _____
 10. Method of hunt: Ground stand _____ Tree stand _____ Still hunt _____
 11. Type of Bow: Regular _____ Compound _____
 12. Comments: _____
-
-
-

Appendix B. Sample questionnaire given to all shotgun hunters during the Fire Island National Seashore deer herd analysis and experimental sport hunt, December 1988 - January 1989.

DAILY QUESTIONNAIRE

Date _____

1. How many hours were you in the field? _____
 2. How many deer did you see in your zone? _____
 3. How many shots did you take? _____
 4. How many deer shot and recovered? _____
 5. What other wildlife did you see in your zone? _____
 6. Did your zone have the vegetation you expected? _____
 7. Was the hunt harder or easier than your expectation? _____
 8. Additional Comments:
-
-
-

Optional:

Name: _____
Telephone: _____