



White-Tailed Deer Ecology on Fire Island

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White-tailed deer (*Odocoileus virginianus*) are well known for their adaptability and propensity to overpopulate their range if not regulated. This trait, along with an association to Lyme disease, has sparked increasing concern over deer populations in many states. Fire Island, along with much of the Northeast, sections of the Midwest (Wisconsin, Minnesota) and portions of California and Oregon, is now an endemic focus for human Lyme disease.

Steady growth of Fire Island's (FI) deer population over the past 10-15 years has followed this scenario. A lack of natural predators, little snow accumulation, a series of relatively mild winters, supplemental feeding by FI residents, and limited "off-island" dispersal opportunities (due to mainland suburban development) have fueled population growth. In the early 1980s, complaints of deer feeding on horticultural vegetation, deer-human conflicts, public pressure to reduce deer numbers, and the documented presence of human Lyme disease cases on FI, prompted a study of the deer population. FI deer, as hosts for the northern deer tick (*Ixodes dammini*), (the primary vector of Lyme disease in the Northeast), have been implicated in the Lyme disease transmission cycle.

Little information existed on FI deer (and barrier island deer populations in general) prior to this study, so several different samples (aerial censuses, winter mortality, vegetation exclosures, blood, tissue, and rumen) were used to evaluate the condition and the annual fluctuation of this population.

Research was conducted by the U/Mass Department of Forestry and Wildlife Management and the NPS North Atlantic Region through a cooperative agreement. Under an Inter Personnel Agreement (IPA), the principal author conducted data analysis at U/Mass as partial fulfillment of a doctoral degree in wildlife ecology and management.



Handling immobilized deer on Fire Island.

Although deer were rarely observed on FI in the early 1970s, their population increased dramatically in the last several years. Aerial censuses, designed with the help of Jim Allen (NARO), revealed a population that nearly doubled between 1983 and 1988. Confronted with a limited opportunity to disperse off FI, increasing numbers have forced deer into FI's human communities.

Data also show that deer are severely hindering regeneration of herbaceous perennials in FI's maritime forest ecosystem. Wildflowers such as aralia (*Aralia nudicalis*) and starflower (*Trientalis borealis*) currently are found growing only among dense tangles of catbrier, which deer cannot penetrate. These species

are beginning to revegetate within deer exclosures. Impacts on vegetation are further evidenced by examining rumen contents. Pitch pine (*Pinus rigida*) needles were found to be a fairly common food of deer even during the summer months, at a time when deer are normally feeding on succulent leaves and fruits to store fat for the winter.

As deer populations increase, they are more subject to environmental perturbations. Detrimental effects of hurricane Gloria (September 1985) were evident in FI's deer population. Due to hurricane force winds (160 km/hr), a large amount of sand was re-deposited and salt spray moved over FI's entire land mass, resulting in premature deciduous plant leaf senescence. Even highly tolerant conifers like pitch pine were stressed by the salt as evidenced by needles turning orange and a significant needle loss. Thus, food available for winter fat storage was greatly reduced.

Serum urea nitrogen has proven a useful winter nutrition indicator in deer. Winter serum urea nitrogen (SUN) levels in fawns on park lands where subsistence is primarily from native vegetation indicated animals with severe undernutrition. SUN levels in fawns where FI residents provide supplemental feeding, did not exhibit as extreme undernutrition. Carcass weights, kidney fat indices, and femur marrow fat further testified to the nutritional status of FI animals.

Winter mortality counts also were used to evaluate the physiological status of FI's deer population. A nearly three-fold increase in mortality over previous winters was observed during the winter following hurricane Gloria, indicating a recently stressed population. Post-hurricane mortality consisted entirely of older animals (>5 years of age) or fawns. In contrast, aerial census counts one year after Gloria showed a 30 percent increase in the deer population over the previous 2 years. Increased mortality rates stimulated reproduction and the total FI population rose to an even higher level.

Using dark-field microscopy, the Lyme disease spirochete (*Borrellia burgdorferi*) was found in 25 percent of all ticks collected from FI deer. This is within the range of tick infection rates reported in the literature. Despite the presence of infected ticks on deer, it is

generally accepted that white-footed mice (*Peromyscus leucopus*) and not deer are the primary spirochete reservoir for infecting ticks. Serial blood samples collected during the winter months showed fluctuating antibody titers to the spirochete. Although still uncertain, the change in titer levels may be attributed to the continual exposure of deer to infected, feeding adult ticks.

It is well known, however, that white-tailed deer are the primary host for the adult stage of the northern deer tick. The role of deer in the ecology of Lyme disease is ill-defined but appears to involve maintenance of tick populations. Recent evidence has shown that elimination of an entire deer population from an island off Massachusetts reduced larval and nymphal deer tick numbers. The evidence is less than convincing however, that removal of deer will eradicate this disease. Despite complete host removal, adult deer tick populations were not lowered. A varied host range for deer ticks and little transovarial transmission of the spirochete is indicative of species involvement other than deer in maintaining the disease cycle.

Nearly 70 percent of all live-trapped deer exhibited elevated antibody titers to *B. burgdorferi* as determined by indirect immunofluorescence (IF). Both IF and Enzyme Linked Immunosorbent Assays (ELISA) are well-established methods of detecting antibody levels to disease agents. An ELISA specifically for deer sera had not been previously reported in the literature and development of such an assay was completed as part of our study. A comparison of the two techniques for deer sera showed similar antibody detection rates.

Deer management is fast becoming a significant issue in many eastern parks. As long as Lyme disease is a public health concern and deer are in any way associated with the disease vector, the public outcry for deer management likely will continue.

Habitat continues to be fragmented by land development and deer populations are becoming increasingly confined to designated parks and reserves. Although dispersal opportunities are limited, contact with humans will increase as deer seek out all potential habitats. Increased feeding pressure on natural areas may ultimately redefine the vegetative component of such systems. Active, rather than passive management will be necessary. Depending on legislative restrictions imposed on various park areas, efficient, effective management programs for deer will require substantial funding sources.

At present, deer research in several eastern parks is ongoing or has been recently completed. As a result, a workshop in FY '89 is scheduled in May by the North Atlantic, Mid-Atlantic, and Southeast Regions to organize the issue of deer management. For one park at least, Fire Island, active deer management will pose a difficult question given the variety of land management uses in an isolated ecosystem. As the pressures of society continue to delimit our natural areas, active deer management is likely to become the rule rather than the exception.

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Blood sampling from Fire Island deer for health indicators and Lyme disease antibody levels.



Live-trapped deer being examined for Lyme disease infected ticks.