Alternatives

2

INTRODUCTION

This chapter describes the various actions that could be implemented for future management of white-tailed deer at Fire Island National Seashore. It provides detailed descriptions of each alternative (no-action and action alternatives), followed by a discussion of adaptive management and how it could be applied to the NPS preferred alternative. The remainder of the chapter addresses alternative elements that were considered but dismissed from detailed analysis, consistency with sections 101(b) and 102(1) of the National Environmental Policy Act, and the NPS preferred and the environmentally preferable alternatives.

OVERVIEW OF ALTERNATIVES

The alternatives selected for detailed analysis are summarized in table 2. The alternatives under consideration include a no-action alternative and three action alternatives.

Action alternatives were developed by the interdisciplinary planning team, which includes the cooperating agencies, with feedback from the public and the science team during the planning process. These alternatives meet, to varying degrees, the management objectives for Fire Island National Seashore and also the purpose of and need for action, as described in "Chapter 1: Purpose of and Need for Action."

ALTERNATIVE A: NO ACTION

Under alternative A: no action, existing deer management and monitoring efforts throughout the Seashore would continue. These actions include continued public education/interpretation efforts, vegetation monitoring, and deer population and behavior surveys.

ACTION ALTERNATIVES

Each of the action alternatives (alternatives B, C, and D) includes the monitoring and education actions proposed under alternative A. In addition, all action alternatives would enhance those education efforts and propose to work collaboratively with the Fire Island communities, New York State Department of Environmental Conservation, New York State Parks, Suffolk County Parks, and local environmental groups on wildlife issues within the Fire Island communities. Each alternative would take action to further reduce undesirable human-deer interactions, protect native plant communities and cultural plantings, promote forest regeneration, and reduce the deer population in the Seashore. Established thresholds for taking action, target deer densities, and target vegetation densities would guide management actions and are described in following section.

Initial Deer Density Goals to Achieve Vegetation Objectives

The Seashore's management goal for the natural areas (Sunken Forest, Fire Island Wilderness, Talisman, Blue Point Beach, Carrington Estate, and William Floyd Estate) is to protect and restore native vegetation communities. Vegetation targets vary between sections of the Seashore as described in chapter 2. To achieve the vegetation targets, the level of deer browsing must change either through exclusion fencing or reduction in deer numbers. Deer densities, based on 2012 sampling, vary widely across Fire Island on federally owned land. For instance, deer density in the immediate vicinity of the Light House Annex was estimated to be 10 deer per square mile, whereas at Sailors Haven (i.e., Sunken Forest), Fire Island Wilderness, and the William Floyd Estate, estimated densities were 112,

54, and 106 deer per square mile, respectively. By comparison, Horsley, Stout, and deCalesta (2003) determined that a deer density exceeding 20 deer per square mile caused noticeable impacts on forest regeneration in the Allegheny National Forest of Pennsylvania. The science team, relying on its professional experience and the scientific literature, recommends a similar population density (approximately 20–25 deer per square mile) as the initial density goal across Fire Island and at the William Floyd Estate lower acreage. The initial density target of 20–25 deer per square mile would be maintained for the first 8–10 years until vegetation is given ample time to display a response, understanding that the deer density target can be adjusted higher or lower through adaptive management based on monitored vegetation impacts and whether vegetation goals are reached.

The Sunken Forest preserve is the only section of the Seashore where herbaceous plants would be used as an indicator of achieving the desired conditions. The science team believes a single deer can do great harm to the herbaceous layer within the Sunken Forest. To meet the desired conditions for vegetation described previously, the science team recommended that no deer be allowed to forage within the Sunken Forest, establishing a target density of zero deer to completely protect this area from deer browse.

TABLE 2. SUMMARY OF THE ALTERNATIVES

ALTERNATIVE ELEMENTS	Alternative A (No Action)	Alternative B	Alternative C	Alternative D (NPS Preferred)
Deer Population Management Methods	**Island-wide:** No actions would be taken to control the deer population size. **Sunken Forest:** No actions would be taken to control deer access to vegetation within the Sunken Forest. **Fire Island Communities:** No actions would be taken on the deer population within the Fire Island communities to reduce negative human-deer interactions. **William Floyd Estate:** No actions would be taken to reduce deer numbers.	**Island-wide:** The deer population would be reduced to and managed at the target density (initially 20 – 25 deer per square mile) using a fertility control agent that meets NPS criteria. **Sunken Forest:** A fence would be erected around the 44 acre Sunken Forest totaling approximately 7,130 linear feet, and all deer would be hazed out of the fenced area to promote understory vegetation establishment and regeneration within the Sunken Forest. **Fire Island Communities:** Deer residing within the Fire Island communities that are observed regularly approaching humans would be translocated to the Fire Island Wilderness. Translocated female deer would be treated with a fertility control agent that meets NPS criteria. **William Floyd Estate:** ▪ The deer population would be reduced to and managed at the target density using a fertility control agent that meets NPS criteria. ▪ An exclusion fence would be installed to protect the historic core area from deer browse totaling approximately 80 acres. ▪ Cattle guards would be installed at the northern entrance gate to prevent deer outside the fence from entering when the gate is opened. ▪ The existing boundary fence would be secured to exclude deer. ▪ Rotational fencing of forested areas in the lower acreage would be installed for two consecutive 10-year rotations based on vegetation recovery monitoring. Approximately 29,700 linear feet of fencing would be installed, and deer would be hazed out of the fenced areas.	**Island-wide:** The deer population would be reduced to and managed at the target density using the following direct reduction methods: ▪ sharpshooting ▪ capture and euthanasia (following American Veterinarian Medical Association guidelines), ▪ public deer hunting at the Fire Island Wilderness **Sunken Forest:** Same as alternative B. **Fire Island Communities:** Deer that are observed regularly approaching humans would be captured and euthanized. **William Floyd Estate:** ▪ The deer population would be reduced to and managed at the target density using direct reduction methods (following American Veterinarian Medical Association guidelines). ▪ Small-scale fencing would be implemented around selected plants important in maintaining the cultural landscape within the historic core area. ▪ Same boundary fencing repair and cattle guard installation as under alternative B.	**Island-wide:** The deer population would be initially reduced using the same direct reduction methods as under alternative C. The deer population would be maintained at the target density using direct reduction methods and/or a fertility control agent that meets NPS criteria. **Sunken Forest:** Same as alternative B. **Fire Island Communities:** Same as alternative C. **William Floyd Estate**: ▪ The deer population would be initially reduced to the target density using direct reduction methods. Fertility control may be used in conjunction with continued direct reduction methods to maintain the deer population at the target density. ▪ Same boundary fencing repair and cattle guard installation as under alternative B. ▪ Approximately 80 acres of the William Floyd Estate, which encompass the historic house and other accessory structures (i.e. the historic core), would be permanently fenced from deer, and hazing would occur to remove deer from within the fenced area.
Education/ Interpretation	Current levels of education/interpretation would continue.	Education/interpretation efforts would be enhanced throughout the Seashore, in Fire Island communities, and adjacent lands in the following ways: ▪ Enhance public education and outreach efforts to raise awareness of the role of humans in deer-related issues. ▪ Improved collaboration with Fire Island communities, New York State, Suffolk County, and environmental groups. ▪ Improved use of web and social media outlets for messaging about deer management. ▪ Enhanced education and enforcement of existing policies regarding deer management and feeding of wildlife.	Same as alternative B.	Same as alternative B.
Deer Population and Behavior Monitoring	Continued monitoring to determine deer densities and behavior of deer would continue annually.	▪ Enhanced monitoring to determine deer densities and behavior of deer would continue annually. – Translocation would be considered for deer that approach humans in the Fire Island Communities.	Enhanced monitoring to determine deer densities and behavior of deer would continue annually.	Same as alternative C.
Vegetation Monitoring	▪ Vegetation monitoring would continue at current levels. ▪ Annual surveys for special-status plants would continue, and protective fencing around special-status plants would continue.	▪ Vegetation monitoring would be enhanced on a frequency of once every three years to measure against established targets within Seashore natural areas, the Sunken Forest, and William Floyd Estate. ▪ Annual surveys for special-status species plants would continue, and protective fencing around special-status species plants would continue.	Same as alternative B.	Same as alternative B.

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THRESHOLDS FOR TAKING ACTION

As described in chapter 1, the Seashore has established desired conditions for various geographic areas of the Seashore. To reach those conditions, specific actions would be required. Actions to be taken have specific goals for success, which are used to help shape the action alternatives presented in this plan/EIS. Thresholds are established that indicate the point at which an action is taken (called a "threshold for taking action" or "action threshold") and are typically tied to a measurable parameter. The action thresholds for the different areas of the Seashore are presented below.

FIRE ISLAND COMMUNITIES

During the course of many deer density surveys over the past decade, Seashore biologists noted variation among individual deer in their reaction to human presence. Some deer exhibit a flight response, some exhibit no response at all, and others were observed approaching people. Biologists recorded the behavior of each deer during surveys to accurately identify and measure the number of deer actively approaching people. Approximately 11% of the deer observed during the surveys between 2008 and 2011 approached the biologists. Additionally, Seashore biologists anecdotally noted that the deer approaching appeared to be the same individuals, suggesting that these returning deer are the cause of many human-deer interactions, likely due to food conditioning. In contrast, only 3% of the deer on federally owned lands that were surveyed (Light House Annex, Sailors Haven, and Fire Island Wilderness) approached the biologists (NPS 2011a).

The National Park Service believes that eliminating all undesirable human-deer interactions is unrealistic. Instead, the focus would be on reducing the percentage of deer that approach people, using the behaviors noted in these surveys as a measure. The Seashore believes that a realistic target for the Fire Island communities would be observing less than 3% of deer approaching the biologists, which is in line with the 2008–2011 detections on federal lands (where there are fewer food attractants) and is a benchmark for how deer behave in less developed areas on Fire Island. If the threshold of 3% is exceeded, the Seashore would take action to reduce the number of deer that approach people as measured by observations during the deer density surveys.

SUNKEN FOREST

The vegetation monitoring data indicates little change in the tree canopy in terms of density, species composition, and importance values since the establishment of the Seashore (NPS 2011b). However the primary concern is that understory regeneration of trees and shrubs needed to replace the midstory and overstory canopy in the Sunken Forest is lacking due to heavy deer browse. For example, in analyzing four important canopy constituents, three showed dramatic declines in density, with blackgum (*Nyssa sylvatica*) and American holly (*Ilex opaca*) being completely absent from sample plots in 2011 (table 3).

TABLE 3. THE DENSITY OF STEMS IN THE SAPLING/SHRUB LAYER FOR THE FOUR IMPORTANT CANOPY CONSTITUENTS IN THE SUNKEN FOREST, SHADBLOW (*AMELANCHIER CANADENSIS*), SASSAFRAS (*SASSAFRAS ALBIDUM*), BLACKGUM (*NYSSA SYLVATICA*), AND AMERICAN HOLLY (*ILEX OPACA*)

Species	DENSITY Stems per acre			
	1967	**1986**	**2002**	**2011**
Shadblow (*Amelanchier Canadensis*)	194±86	129±47	65±65	57±36
Sassafras (*Sassafras albidum*)	24±18	32±25	8±8	73±34
Blackgum (*Nyssa sylvatica*)	57±43	8±8	8±8	0
American holly (*Ilex opaca*)	16±11	8±8	0	0
Total	291±41	178±29	81±15	129±19

Notes: Data available from permanent plots in the Sunken Forest (Art 1976, 1987; Forrester 2004; NPS 2011b).
Values are means ± standard errors.

The Seashore intends to monitor stem densities in the sapling and shrub layers of those key constituents as the targeted measure for reaching the desired condition. The 1967 stem density data was selected as a guide for determining which species to measure and what the target densities should be.

The Seashore has chosen four woody species (dominant canopy constituents) and two species of understory shrubs that were relatively common in 1967 (Art 1976) as the target species: shad blow (*Amelanchier canadensis*), sassafras (*Sassafras albidum*), blackgum (*Nyssa sylvatica*), American holly (*Ilex opaca*), chokeberry (*Aronia arbutifolia*), and inkberry (*Ilex glabra*) (table 4). The action thresholds for these sapling and shrub species are based on the 1967 densities and are provided below (measured in terms of individuals greater than 3.28 feet [1 meter] in height and less than 1.2 inches [3 cm] in diameter at breast height [dbh]).

TABLE 4. ACTION THRESHOLDS FOR SAPLINGS AND SHRUBS

Species	Action Threshold (stems per acre)
Shad blow (*Amelanchier canadensis*)	Less than 101 stems per acre (250 stems per hectare)
Sassafras (*Sassafras albidum*)	Less than 16 stems per acre (40 stems per hectare)
Blackgum (*Nyssa sylvatica*)	Less than 40 stems per acre (100 stems per hectare)
American holly (*Ilex opaca*)	Less than 8 stems per acre (20 stems per hectare)
Chokeberry (*Aronia arbutifolia*)	Less than 101 stems per acre (250 stems per hectare)
Inkberry (*Ilex glabra*)	Less than 113 stems per acre (280 stems per hectare)

The presence or absence of species and percent cover of ground cover plants (herbaceous, woody, and liana) were surveyed in permanent plots in 1967, 1986, 2002, and 2011. This data showed that a number of species were present in 1967 but absent from the 2002 and 2011 surveys: Carolina rose (*Rosa carolinia*), small cranberry (*Vaccinium oxycoccus*), wild sarsaparilla (*Aralia nudicaulis*), cinnamon fern (*Osmunda cinnamomea*), starry false lily of the valley (*Maianthemum stellatum*), seaside goldenrod (*Solidago sempervirens*), inkberry (*Ilex glabra*), and winged sumac (*Rhus copallinum*). The Seashore would like to see a return of these species as part of the regeneration effort. However, formulating target thresholds for each of these ground cover plants would prove difficult, given the evolutionary traits of each species (i.e., seasonal growth and flowering patterns) and other site-specific abiotic factors (i.e., degree of sunlight, soil, moisture and fertility) that change from year to year. Furthermore, the National Park Service realizes that achieving a

quantifiable target might be difficult for some species that have been absent from the forest for so long and may not be plentiful in the seed bank (Forrester 2004). Instead, the Seashore would be satisfied with achieving a presence of those ground cover plants that were common in 1967 but are rare or missing today. To measure this, the Seashore has elected to choose wild sarsaparilla (*Aralia nudicaulis*) and starry false lily of the valley (*Maianthemum stellatum*) as the indicator ground cover species, because both are imperiled within the Sunken Forest and both serve as important indicators of browsing pressure. The Seashore would continue measuring the vegetation within the permanent plots to record the presence or absence and percent cover of these two species.

OTHER FIRE ISLAND NATURAL AREAS

Thresholds for other forested areas on Fire Island (other than the Sunken Forest) and the William Floyd Estate were established using a combination of actual data collected at each site (NPS 2013e, NPS 2013f), long-term data collected in the Sunken Forest, the scientific literature, and professional experience and opinions. Seashore staff would extend the data collection to other maritime forests in the future. A comprehensive dataset would be useful in fully understanding understory conditions throughout each of the natural areas, but this dataset is not complete. For the Talisman and Blue Point maritime forests, preliminary data indicate that regeneration of forest overstory constituents have been impacted by deer browse, and the Seashore would like to restore forest seedling growth. Success would be determined by an understory seedling density target of 2 seedlings per square meter (excluding black cherry) based on a weighted scale of seedling size as described in appendix B.

WILLIAM FLOYD ESTATE

Historic House and Surrounding Landscape

The historic core area of the William Floyd Estate would require successful establishment of key ornamental plantings for the cultural landscape to be restored. The Seashore intends to annually monitor the condition of ornamental plantings to determine relative condition. Deer browsing heavy enough to result in poor vegetation growth and vegetation mortality would serve as a threshold for taking action to control deer browse. Seashore staff would assess and document the general condition of the cultural plantings and rely upon professional judgment of qualified cultural landscape experts to determine whether corrective action is needed. The future cultural landscape treatment plan would identify more detailed thresholds for taking action, once completed.

William Floyd Estate Forests

The forested areas of the William Floyd Estate would be managed as natural areas separate from the historic core area. The number of tree seedlings would be the action threshold indicator. The Seashore selected an action threshold based on available research on forest regeneration and the regeneration standard adopted by the Pennsylvania Regeneration Study (USDA Forest Service 2013). This standard has also been adopted by the New York State Department of Environmental Conservation as part of their recent statewide deer management plan (NYS-DEC 2011). The Pennsylvania Regeneration Study is a component of the Forest Inventory and Analysis (FIA) Program being implemented nationwide by the U.S. Forest Service (USDA Forest Service 2013). The FIA program has collected data in Pennsylvania forests since the 1950s; however, sampling occurred on a "periodic" basis every 10–15 years. Data collection has intensified with surveys being conducted on a 5 year rotation (McWilliams et al. 2004). Based on this study, forest regeneration targets (adequate recruitment) for the William Floyd Estate would be reached when an average of 2 seedlings (native and deer preferred species) per square meter (8,079 seedlings per acre) are

observed (McWilliams et al. 2005). To monitor for vegetation targets, the densities of living seedlings greater than 5 cm in height but less than 1 cm dbh are recorded within the four 1 square meter subplots located at the corners of each 100 square meter (10 × 10 m) plot. There are four height class categories that are surveyed, and weighting factors are applied to each seedling according to its height class (see appendix B for details).

ALTERNATIVE A: NO ACTION

Under the no-action alternative, the Seashore would continue to implement current management actions, policies, and monitoring efforts related to deer and their effects. Current actions within the Seashore include limited public education/interpretation efforts, vegetation monitoring, and deer population surveys. The actions that would continue under alternative A are described below in detail. These actions are also common to all action alternatives.

EDUCATION/INTERPRETATION

The Seashore would continue to disseminate information related to human-deer issues using a variety of means. Interpretive exhibits, waysides, and print media regarding natural resources and resource issues such as keeping wildlife wild, preventing Lyme disease, and other topics would continue to be offered at visitor contact locations and would be made available to Fire Island communities where possible. Interpretive rangers and other members of the Seashore's staff would also continue to provide information on these topics at visitor contact stations, and offer interpretive programs focused on white-tailed deer and human-wildlife issues at Seashore sites and within Fire Island communities as feasible. Finally, relevant information would be posted on the Seashore's website, social media platforms, and through local news outlets.

VEGETATION MONITORING

Vegetation monitoring would continue. Only vegetation on federal tracts within the boundaries of the Seashore is surveyed. Areas that fall within this plan/EIS are (from west to east) the Light House Annex, Sunken Forest, Carrington Estate, Talisman, Blue Point Beach, Fire Island Wilderness, and William Floyd Estate. Due to the variety of habitat types, different sampling protocols are established for each area. Sampling occurs annually, with each area being sampled once every five years.

Special-Status Plant Species

The Seashore performs annual surveys across the entire length of Fire Island in search for special-status plants that occupy beaches and foredunes. When special-status plants are discovered occupying these dune habitats, Seashore staff often place small-scale screens around individual plants or colonies to protect them from deer browse. This practice would continue under alternative A.

DEER MONITORING

Behavior Monitoring

Deer behavior monitoring is completed in conjunction with the deer population monitoring. Each year, three biologists traverse pre-determined transects to record the presence of deer. Surveys are initiated either 20 minutes before official sunrise or timed so the survey is finished just before

sunset. This is to ensure sampling is conducted when deer are most active. When conducting the survey from within a vehicle, speeds are constrained to no more than 10 mph. Two different kinds of deer behavior are recorded: (1) initial behaviors, including feeding behaviors and forage type (if applicable); and (2) reaction to observers. Initial behavior refers to the behavior that the majority of the group of deer is engaged in at the time of detection. Habituation and reactive behaviors describe response to the observer's presence; an individual or group of deer within a detection is considered "unaffected" if they do not visibly react to the observer's presence. The behaviors during the surveys could be "affected" by the distance of the deer from the transect, and whether an individual or deer group is aware of the observer's presence.

Deer Population Monitoring

Deer population monitoring, described in appendix C of this document, would continue. This monitoring includes distance sampling surveys to estimate white-tailed deer densities as well as deer behavior monitoring (described above). Fire Island community sites and most natural areas (including the Sunken Forest) on Fire Island are surveyed every year, whereas the William Floyd Estate and Fire Island Wilderness are surveyed every three years. Deer population data collected in the field includes aspects of herd composition such as sex, age (fawn/adult), and group size.

Incident Reporting and Response

Seashore park rangers report wildlife-related incidents throughout the boundaries of the Seashore while roving or when directly contacted by visitors. All deer-related incidents occurring in the Fire Island communities are reported to the NYS-DEC's Wildlife Reporting Hotline. Seashore park rangers would assist with each incident as needed.

ELEMENTS COMMON TO ACTION ALTERNATIVES

In addition to continuing the elements described under alternative A (public education/interpretation efforts, incident reporting and response, deer and vegetation monitoring), the actions described below are common to alternatives B, C, and D. In addition to these actions, all action alternatives incorporate adaptive management approaches, which are described in detail in "Adaptive Management Approaches Included in the Action Alternatives."

ENHANCED PUBLIC EDUCATION/INTERPRETATION EFFORTS

Seashore staff would enhance public education/interpretation efforts within Fire Island communities and communities adjacent to the William Floyd Estate to raise awareness of the role of humans in deer-related issues. Actions could include the following:

- Work collaboratively with Fire Island communities, New York State Parks, Suffolk County Parks, and local environmental groups to develop, share, and use consistent and strategic messaging with regard to human-deer interactions and deer management on Fire Island.
- Dedicate interpretive effort where feasible to conduct outreach and provide interpretive media in the Fire Island communities on the topic of living with deer. This would include education on deer biology and ecology, supplemental food source reduction (i.e., garbage management), and gardening with deer-resistant native plants.
- Improve use of web and social media pages to engage virtual visitors in an online discussion on human-deer interactions and deer management. This could include developing an interactive web-based activity on the Seashore's "For Kids" page.

- Develop a curriculum-based education program centered on the topic of deer issues on Fire Island.
- Implement a citizen-science project engaging Fire Island community residents and residents adjacent to the William Floyd Estate in deer and vegetation research and monitoring.
- Enhance education and enforcement of existing policies related to deer management and feeding of wildlife within NPS boundaries.

FENCING OF THE SUNKEN FOREST

The 44-acre globally rare maritime holly forest at the Seashore known as the Sunken Forest has incurred understory impacts from heavy deer browse for decades. Scientists believe that attempts to restore understory vegetation—herbaceous vegetation in particular—could be disrupted by a single foraging deer, and the only way to prevent deer browsing impacts completely is the installation of an exclusion fence. Each of the action alternatives, therefore, would include an exclusion fence approximately 7,130 feet long and 10 feet tall surrounding the maritime holly forest type within that portion of the Sunken Forest preserve called out in the enabling legislation (figure 3). The location of the fence would be dictated by minimizing environmental impacts (particularly to wetlands), minimizing structural conflicts with existing boardwalks, and the potential for long-term bayside shoreline erosion due to increasing water levels resulting from sea-level rise. As a mitigating step to offset impacts caused by construction of the fence, the Seashore would consider collecting desirable herbs and shrubs and replanting those plants within the area of disturbance.

SECURING THE BOUNDARY FENCE AT THE WILLIAM FLOYD ESTATE

The outlining fence along the property boundary of the William Floyd Estate is an aging chain-link structure. Over the years, the fence has incurred damage from vandals and storms, and animals have burrowed under the fence creating small gaps of sufficient space for deer to freely crawl through. To best control the deer density, each action alternative includes enhancements and/or replacement of the property fence. In addition, when staff have approached gates at the William Floyd Estate to unlock for vehicular passage, deer have been observed quickly passing through the gates as soon as they are opened. As part of the deer management plan to prevent deer movements through vehicular gates, each of the action alternatives includes provisions to install cattle gates at each vehicular gate.

ENHANCED VEGETATION MONITORING WITHIN NATURAL AREAS

Biologists recently began an expansive monitoring program to record baseline conditions of the vegetation within these natural areas and to observe changes in vegetation over time, as described in appendix B. Monitoring requires permanent vegetation plots for which comparisons can be made. Data collection would occur annually, with each natural area being sampled at least once every three years. This enhanced vegetation monitoring is described under alternative B.

SMALL-SCALE FENCING OF SPECIAL-STATUS PLANTS

As described under alternative A, the Seashore would continue annual searches for those special-status plant species occupying beaches and foredunes that are vulnerable to deer browse impacts. When special-status species plants are discovered, the Seashore would install small-scale fencing around the plants to protect them from deer browse.

LEGEND

Sunken Forest Preserve

Sunken Forest Trail/Boardwalk

Sunken Forest Fence

0 400 Feet

Source: NPS GIS Data; Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GREAT SOUTH BAY

Sunken Forest

Sailors Hvn

Fire Island Beach Road

Great South Beach

ATLANTIC OCEAN

White-tailed Deer Management Plan and Environmental Impact Statement

National Park Service
U.S. Department of the Interior

Fire Island National Seashore

FIGURE 3

Sunken Forest Proposed Fencing - All Action Alternatives

ENHANCED DEER POPULATION MONITORING

Monitoring deer numbers is a critical element of the plan to measure deer densities relative to observed changes in vegetation. Under each of the action alternatives, enhancement of deer monitoring efforts would occur by increasing the monitoring events across all regions of the Seashore to an annual basis. During deer density counts, staff would record observed deer behavior as a means of indexing the frequency of undesirable human-deer interactions. This data would be a key component in determining whether Seashore goals are met and any adaptive management actions throughout the implementation of the plan. This enhanced monitoring is described in appendix C.

MINIMUM REQUIREMENTS ANALYSIS

NPS *Management Policies 2006*, section 6.3.5, "Minimum Requirement" states that all management decisions affecting wilderness must be consistent with the minimum requirements concept. This concept is a systematic process used to determine if administrative actions, projects, or programs affecting wilderness character, resources, or the visitor experience are necessary, and if so, how to minimize the resulting impacts.

The term "minimum requirements" comes from section 4 (c) of the Wilderness Act, which states "…except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act…" The minimum requirement decision process involves two steps. First, to determine if any administrative action is necessary to meet minimum requirements for administration of the area for the purpose of the Wilderness Act, and if so, to then determine the minimum activity (method or tool) needed to accomplish the action which would have the least impact on the wilderness resource, character, and purposes.

The National Park Service would complete a minimum requirement analysis for the NPS preferred alternative prior to implementation, striving to minimize the extent of adverse impact while accomplishing the Seashore's necessary wilderness objective.

COORDINATION WITH STATE

The NYS-DEC regulates the hunting and collection of animals by the public through the issuance of permits. In addition, once a fertility control agent (discussed in more detail below and not applicable to alternative C) is approved for use by the Environmental Protection Agency (EPA), the agent must also be registered for use in New York. Registration of any agent would include labeled restrictions. By law, any landowner using the agent would need to comply with these labeled restrictions. The Seashore, in implementing this plan/EIS, would work closely with NYS-DEC. Coordination would include routine meetings with NYS-DEC staff, data sharing, public relations, and reporting.

DEER POPULATION MANAGEMENT ACTIONS CONSISTENT WITH ALTERNATIVES B AND D

FERTILITY CONTROL

Reproductive control in wildlife management has been assessed for several decades across multiple species. Its use has gained more attention as the public has become more interested in wildlife management decisions. For reproductive control agents to effectively reduce deer population size, they must decrease the reproductive rate to less than the mortality rate. In urban deer populations, mortality rates are generally very low (approximately 10%). Also, to control the growth of the deer population, it is necessary to treat 70%–90% of the female deer with a highly effective product to successfully reduce or halt population growth in a closed population without immigration or emigration (Rudolph, Porter, and Underwood 2000; Hobbs, Bowden, and Baker 2000). The science and understanding of fertility control are evolving. The most updated information about fertility control is summarized in appendix D. The terms fertility control and reproductive control are used synonymously in this document.

Two categories of reproductive control technology were considered: chemical reproductive control agents and surgical sterilization. Chemical reproductive control agents offer great promise for future wildlife management (Rutberg et al. 2004), as described in appendix D. Surgical sterilization was considered but dismissed based on the criteria established for fertility control (see "Alternative Elements Considered but Dismissed" at the end of this chapter).

Several chemical reproductive control agents (immunological and nonimmunological) are being developed and tested for use in deer population control (Fagerstone et al. 2010). These include the standard porcine zona pellucida (PZP) vaccine (Kirkpatrick et al. 1992; Turner, Kirkpatrick, and Liu 1996; Naugle et al. 2002; Miller et al. 2009); uniquely formulated PZP, such as SpayVac® (Fraker et al. 2002) and long-acting formulations of native PZP (Rutberg et al. 2013); GnRH vaccine (Miller et al. 2000, 2001; Curtis et al. 2002; Fraker et al. 2002; Gionfriddo et al. 2009, 2011); and Leuprolide (Baker et al. 2002, 2004). Each of these agents is described briefly in table 5 and in more detail in appendix D.

TABLE 5. CHEMICAL REPRODUCTIVE CONTROL AGENTS

Issue	Standard (Native) PZP Vaccine	SpayVac® PZP Vaccine	GnRH Vaccine (e.g., GonaCon™)	Leuprolide (GnRH agonist)
Mode of Action	Blocks sperm penetration and fertilization; estrous cycles continue	Blocks sperm penetration and fertilization; estrous cycles continue	Prevents secondary hormone (luteinizing hormone [LH] and follicle stimulating hormone [FSH]) secretion, which stops folliculogenesis and ovulation	Prevents secondary hormone (LH and FSH) secretion, which stops folliculogenesis and ovulation
Mode of Administration	Injection	Injection	Injection	Injection
Number of Doses	Twice initially and annual booster	Once initially and booster when needed	Once initially and booster when needed	Current formulation – annually
Timing	Treated prior to breeding season to allow sufficient time for antibody development	Treat prior to breeding season and allow sufficient time for antibody development	Treated prior to breeding season and allow sufficient time for antibody development	Treated immediately prior to breeding season on an annual basis

The current research related to chemical reproductive control technologies offers highly variable results in terms of key elements such as contraceptive efficacy and duration (appendix D). As stated above, there are also logistical issues related to the administration of these drugs that could have substantial implications for success and sustainability. Therefore, only when the following criteria are met would reproductive control be implemented as a management tool.

1. The fertility control agent is federally approved and state-registered for application to free-ranging white-tailed deer populations.
2. The agent provides multiple-year (three or more) efficacy (80%–100%) to minimize the cost and labor required to administer the drug to a large number of deer.
3. The agent can be administered through remote injection to avoid capturing the animal on a regular basis and to increase the efficiency of distribution.
4. The agent would leave no harmful residual in the meat (meat would be safe for human and non-target animal consumption).
5. The agent would have minimal impact on deer behavior (e.g., reproductive behaviors, social behaviors, out of season estrous cycling).

Such an agent is not currently available. Regardless, because Seashore staff anticipates an agent that meets all NPS criteria would be available upon implementation or within the next 10 years (as research and development continues), this tool has been retained as part of the range of alternatives. However, evaluation of existing agents using criteria for an acceptable agent showed that GonaCon™ met more of the criteria than other chemical reproductive control agents (table 6).

TABLE 6. EVALUATION OF FERTILITY CONTROL BASED ON SELECTION CRITERIA FOR FIRE ISLAND NATIONAL SEASHORE

Agent	Criterion 1 Federally Approved and State Registered	Criterion 2 Multiyear Efficacy (3+)	Criterion 3 Capable of Remote Administration	Criterion 4 Meat Safe for Humans	Criterion 5 Minimal Impact on Deer Behavior
Immunocontraceptives					
"Native" PZP	No	No	Yes	Likely, but need EPA approval	No – repeated estrous cycles
SpayVac®	No	Possibly[a]	Unknown	Likely, but need EPA approval	No – repeated estrous cycles
Long-term Pelleted PZP	No	Possibly[b]	No	Likely, but need EPA approval	Unknown – likely repeated estrous cycles
GnRH (GonaCon™)	No[c]	Possibly[d]	Possibly[e]	Yes	Yes
GnRH Agonists					
Leuprolide Acetate	No	No	Yes	Likely but need EPA approval	Yes
Histrelin Acetate	No	No	No	Likely but need EPA approval	Unknown
Other					
GnRH Toxins	No	Unknown	Unknown	Likely but unknown	Unknown
Steroid Hormones	No	No	Unknown	Unlikely, but need regulatory guidance	Unknown
Contragestives	No	No	Yes	Yes	Yes

TABLE 6. EVALUATION OF FERTILITY CONTROL BASED ON SELECTION CRITERIA FOR FIRE ISLAND NATIONAL SEASHORE (CONT'D)

Agent	Criterion 1 Federally Approved and State Registered	Criterion 2 Multiyear Efficacy (3+)	Criterion 3 Capable of Remote Administration	Criterion 4 Meat Safe for Humans	Criterion 5 Minimal Impact on Deer Behavior
Other					
Physical Sterilization – Ovariectomy	Not applicable[f]	Yes - permanent	No	Yes – after anesthesia withdrawal date	No – lack of reproductive hormones will change reproductive behaviors and likely social behaviors
Physical Sterilization – Tubal Ligation	Not applicable[f]	Yes - permanent	No	Yes – after anesthesia withdrawal date	No – repeated estrous cycles

a SpayVac® has demonstrated 80%–100% efficacy for up to 5–7 years in horses and deer (Fraker, pers. comm., 2009; Miller et al. 2009; Killian et al. 2008). The term "possibly" is used because long-term studies (greater than 5 years) have been conducted only in captive deer and had a small sample size in each treatment group (N=5) (Miller et al. 2009). The only longer term study in free-ranging white-tailed deer did not evaluate past the third year (Rutberg et al. 2013).

b Long-term pelleted PZP has not been adequately evaluated past year 2 in free-ranging deer to determine extended efficacy (Rutberg et al. 2013).

c Federally approved but not registered in New York state for use in free ranging white-tailed deer populations.

d Research on one-shot, multiyear GnRH vaccine in penned/captive deer indicates GonaCon is 88%–100% effective in year 1, 47%–100% effective in year 2, and 25%–80% effective up to 5 years post-treatment (Miller et al. 2008). The term "possibly" is used because the 3+ year efficacy has only been demonstrated in captive deer, with small sample size, and lacks confidence intervals. Work in free-ranging deer suggests lower efficacy rates and shorter duration of efficacy (Gionfriddo et al. 2009, 2011).

e Work published in elk used dart delivery to administer the GnRH vaccine (Killian et al. 2009). However, the current label for GonaCon™ requires it to be hand injected.

f Not applicable because this is a veterinary procedure rather than a product. The procedure requires general anesthesia, a veterinarian to perform surgery, post-operative antibiotics, and is likely associated with a higher mortality rate (approximately 6%; MacLean et al. 2006) than anesthesia alone (approximately 1.5%; Rutberg et al. 2013). Results in permanent sterilization.

Under alternative B, the Seashore would not be able to initiate a reproductive control program until a chemical reproductive control agent meeting all criteria becomes available. Prior to the availability of an acceptable agent, all other components of alternative B would be implemented following initiation of this plan. The availability of an acceptable agent would also limit the options available to the park for population maintenance under alternative D (but direct reduction methods would be available for use under this alternative).

The Seashore would monitor the status of reproductive control research on a periodic basis through consultation with subject matter experts and review of new publications. When new information and/or advances in the use of reproductive control agents could benefit deer management in the Seashore and established criteria are met, the decision to use an appropriate chemical reproductive control agent would be determined by the Seashore. This determination would be made based on how well the criteria for an acceptable control agent are met and on availability, cost, efficacy, duration, and safety at the time the action was implemented. The determination of an appropriate control agent is discussed further in "Adaptive Management Approaches Included in the Action Alternatives."

ADMINISTRATION OF THE REPRODUCTIVE CONTROL AGENT

Number of Females Treated at Fire Island

To effectively reduce deer population size, treatment with a reproductive control agent must decrease the reproductive rate to less than the mortality rate. The actual deer mortality rates at Fire Island and at the William Floyd Estate are not known; however, these rates are expected to be low particularly on Fire Island in the absence of hunting, given that few, if any, deer die from motor vehicle collisions, a high source of mortality in most urban deer populations. Fire Island, like many other suburban deer populations, has a high number of artificial food sources, which could contribute to a lower mortality rate.

Thus, under alternative B, it is assumed that it would be necessary to treat approximately 70%–90% of the females in order to reduce deer population growth (Hobbs, Bowden, and Baker 2000; Rudolph, Porter, and Underwood 2000). After several years of application at this rate of treatment, a small (e.g., 5 %) reduction in the deer population could be expected (Hobbs, Bowden, and Baker 2000). However, in a deer management plan completed at Valley Forge National Historical Park, a deer population model indicated that the reduction in the deer population using a reproductive control agent could be more than that, possibly up to 33% after 5 years and up to 60% after 10 years (NPS 2009c). These estimates from Valley Forge National Historical Park are similar to findings at the Fire Island communities of Kismet to Lonelyville (Rutberg and Naugle 2008). This western segment of Fire Island has the longest history of fertility control (PZP) research, from 1993–2009. Rutberg and Naugle (2008) included population data collected using distance sampling from 1995–2006, and deer density declined by ~58% from 1997–2006 (approximately 85–35 deer, respectively). Alternatively, population reduction through PZP treatment was nominal in other portions of Fire Island (Naugle et al. 2002; Underwood 2005), reflecting the logistical challenges associated with implementing fertility control treatments.

The Seashore's 2012 deer population on Fire Island was estimated at 194–392 deer, based on deer density of surveyed lands (about 3.926 square miles). Deer density survey data collected by the National Park Service indicate that approximately 58% of the deer in the Seashore (113–227 deer) are females. Under alternative B, approximately 100–205 females (~90% of 113 and 227) would be treated in the first year and then every three years, assuming minimal deer population reduction (~5%). At the other end of the spectrum, assuming a deer population reduction similar to what was observed on Fire Island (Kismet to Lonelyville) and predicted at Valley Forge National Historical Park, approximately 100–205 deer would be treated years 1 and 4, approximately 70–140 deer would be treated in years 7 and 10, and approximately 40–80 deer would be treated in year 13. All numbers are approximate and would depend on how the deer population responds; therefore adaptive management approaches would be key to a successful program.

Number of Females Treated at the William Floyd Estate

The Seashore's 2012 deer population at the William Floyd Estate was estimated at 66–141 deer, based on the deer density of surveyed lands (about 0.9043 square miles). Deer density survey data collected by the National Park Service indicate that approximately 73% of the deer at the William Floyd Estate (48–103 deer) are female. At the high range, the number of females that would be treated ranges from 45–95 (~90% of 48 and 103) for the first year and then every three years, assuming minimal deer population reduction (~5%). At the other end of the spectrum, assuming a deer population reduction similar to what was observed on Fire Island (Kismet to Lonelyville) and predicted at Valley Forge National Historical Park, approximately 45–95 deer would be treated years 1 and 4, approximately 30–60 deer treated in years 7 and 10, and approximately 20–40 deer treated in year 13. All numbers are approximate and adaptive management is key to a successful program.

Application Procedures. Regardless of the reproductive control agent used, treated females would need to be marked (tagged) to facilitate identification of which deer have been treated, to avoid multiple treatments of the same individuals. For most marking techniques, each deer must be captured and handled at least once for the first treatment. Tracking and capturing previously treated females would require time to locate the deer or to lure it to a capture site so that it could be treated. After deer have been handled, successfully capturing them for subsequent treatments can become difficult (Rudolph, Porter, and Underwood 2000).

Training. Regardless of the technique implemented, qualified federal employees or contractors with demonstrated experience in the administration of reproductive control would perform these activities. NPS employees and contractors performing the darting would be required to successfully complete training on the use and storage of a dart gun, as well as on the administration of anesthesia and the fertility control agent. This training is important to ensure the safety of NPS employees, contractors, and Seashore visitors. Federal employees or contractors also would need to be qualified to handle live deer in order to minimize harm to the animal or the employee. If more than one location were simultaneously used to remotely administer controls with tranquilizer darts, these areas would be adequately separated for safety reasons.

MONITORING

Additional monitoring to document reproductive control success (pregnancy rate, and reproductive rate) would be implemented. Data collected from monitoring would be used to test the accuracy of modeling results to reduce modeling uncertainties. It would be expected that as the number of females treated with a reproductive control agent increased over time, the percent of pregnant females would decrease. Data on reproductive rates also would be used to describe the existing deer population. Detailed monitoring plans are included in appendixes B and C.

ALTERNATIVE B

Under alternative B, deer observed approaching humans (during distance sampling surveys) within the Fire Island communities would be translocated to the Fire Island Wilderness. In addition to the common to all actions described above, deer browsing management actions would include fencing of an area encompassing the historic core at the William Floyd Estate (approximately 80 acres), and rotational fencing of selected forest areas at the William Floyd Estate lower acreage (approximately 66 acres at one time). The fencing would be implemented in conjunction with fertility control of white-tailed deer to gradually reduce and then maintain the deer population at an appropriate density to achieve the plan objectives for vegetation (estimated at 20–25 deer per square mile across Fire Island and the William Floyd Estate). Fertility control would be implemented using a chemical reproductive control agent (when an acceptable agent, i.e., an agent meeting criteria specified in the plan/EIS, becomes available). For the purpose of this plan/EIS and for the purpose of including a diverse array of management alternatives, the Seashore assumes that an acceptable reproductive control agent meeting all of the established criteria would be available within 10 years of the drafting of this document. Once adequate levels of tree seedling recruitment have been reached at the William Floyd Estate, it may be possible to eliminate or reduce fencing. This would be assessed using adaptive management.

FENCING

Fencing would be used to exclude deer from the maritime holly forest known as the Sunken Forest (approximately 44 acres of fenced area) and the William Floyd Estate (figures 3 and 4). At the William

Floyd Estate, both an area encompassing the historic core—approximately 80 acres—and rotational fencing in the lower acreage would be constructed. Rotational fencing would create four defined areas, ranging in size from 8–37 acres and totaling approximately 66.5 acres in the first 10 years, then approximately 65 acres in the second 10 years. When defining exclosure locations and the amount of fencing required, Seashore staff would consider the proposed locations in relation to historic structures, cultural landscapes, visitor-use areas, Seashore boundaries, accessibility, known archeological resources, the trail system, and maintenance requirements. High-use visitor areas, areas with the potential for adverse visual impacts, and areas with high maintenance requirements (e.g., floodplains) would be avoided as much as possible. Large fenced areas would be constructed on Seashore property at least 100 feet from the Seashore boundary to provide adequate construction area and minimize impacts on neighboring properties. Prior to fence construction, archeological surveys would be conducted at fence post locations.

The fences would be a minimum of 8–10 feet high and mesh size would be sufficient to allow most small animals to move freely through the fence. It is expected that technical details (e.g., type of footer, post type, and spacing, etc.) would vary based on factors such as topography, geologic substrate, access, potential visibility, and presence of archeological resources. This information would be provided on a site-by-site basis through development of a detailed implementation plan. Electric fencing would not be used in the Seashore based on concerns for visitor safety, potential impacts on other native wildlife, and long-term maintenance requirements.

Deer would be driven out of the fenced areas by Seashore staff before completing the fencing. Visitors would be allowed within the fenced areas at the Sunken Forest and the William Floyd Estate historic core. Visitors would not be able to use the areas enclosed by rotational fences (William Floyd Estate lower acreage) during or after construction. All fencing would be monitored by Seashore staff and maintained by contract with a local fence company. Monitoring of all fenced areas would consist of visual inspection for fence integrity and would be coordinated with vegetation monitoring activities. If any deer were found within a fenced area, they would be driven out of the fenced area by Seashore staff.

The timeline for the duration that fences would remain in place differs between the Sunken Forest and the William Floyd Estate. For the Sunken Forest and the William Floyd Estate historic core area, fences would be permanent. At the William Floyd Estate lower acreage, rotational fences would be used to protect vegetation from deer browse. It is estimated that it would take at least 10-15 years to achieve an adequate level of regeneration within the rotationally fenced areas at the William Floyd Estate (8,079 tree seedlings per acre) and for seedlings to exceed the typical deer browsing height (approximately 60 inches) (Horsley, Stout, and deCalesta 2003). Once monitoring within the fenced area indicated adequate regeneration and tree seedlings exceeded browse height, the rotational fencing would be moved to immediately adjacent areas in order to reuse one side of the previous fenced area, thus minimizing relocation and labor costs.

DEER TRANSLOCATION

The method of capturing and moving deer from one area to another would be considered in alternative B of the plan/EIS. Translocation is not considered a long-term solution; however, it may have applicability in the short term while human behaviors that cause and perpetuate undesirable human-deer interactions are being reduced in the Fire Island communities to the extent possible.

Translocation would be considered only for those deer that approach humans in the Fire Island communities to achieve the plan's objective of reducing undesirable human-deer interactions. Individuals would only be captured from Fire Island communities west of Sailors Haven. Captured females would be treated with a fertility control agent, and all captured animals would be

translocated to the Fire Island Wilderness where the deer population is estimated to be approximately 100 individuals. Seashore biologists have observed natural fluctuations in the deer population at the Fire Island Wilderness, which has been between 100 and 150 deer. Translocating deer to the Fire Island Wilderness would cause a slight increase in the population density in that area. However, biologists have concluded that the density would remain within the natural range of population variability. Biologists also have concluded that translocating deer to the Fire Island Wilderness would cause browsing pressure to remain within the range experienced under natural fluctuations of the population. Vegetation would need to be monitored and if impacts are observed, alternative actions would need to be taken through the adaptive management process (any adjustments not covered in this plan would require additional planning and compliance).

Deer that approach humans would first be identified by NPS staff based on behavior observations during deer monitoring surveys. These individual deer would be captured and/or anesthetized and then transported to the Fire Island Wilderness, most likely by truck. Decisions regarding the implementation of this method would be made based on efficiency, the minimum requirements and tools necessary to carry out the task (in the context of wilderness management), and safety for both the animal and the handler. All precautions would be made to minimize stress to the animal as well as handling time. Release sites in the Fire Island Wilderness would be identified but should be no less than 4 miles from Davis Park (the easternmost Fire Island community). Reproductive control (as part of alternative B) would occur before the individual deer is released into the Fire Island Wilderness.

All individuals would be marked to track their survival, movements, and behaviors after translocation. An assessment of each translocated individual would be made every year to determine the success of the translocation efforts. Capture and euthanasia would be considered for translocated individuals that consistently return to Fire Island communities and/or continue to approach humans.

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FIGURE 4
William Floyd Estate Proposed Fencing - Alternative B

ALTERNATIVE C

Under alternative C, deer browse would be managed through exclosure fencing in the Sunken Forest (approximately 44 acres of maritime holly forest) and small-scale fencing to protect special-status species and key plants within the William Floyd Estate historic core. Actions would be taken to reach vegetation recovery and forest regeneration goals by directly reducing and maintaining the deer browsing pressure through use of direct reduction methods. These methods also would be used to maintain the deer density at a density where vegetation can successfully regenerate (initially 20–25 deer per square mile Seashore-wide). Deer population reduction and maintenance would be implemented through a combination of sharpshooting, capture and euthanasia of individual deer (where necessary), and public hunting (within the Fire Island Wilderness only). Deer observed approaching humans within the Fire Island communities would be captured and euthanized.

FENCING

Vegetation management actions under alternative C would vary depending on the location. Fencing of the Sunken Forest and small-scale fencing of special-status plant species island-wide would take place as described under alternative B. At the William Floyd Estate, small-scale fencing and/or protective barriers would be established within the historic core to protect key cultural landscape plantings, and key species would be replanted as needed to restore the cultural landscape. Decisions on appropriate plant species and their locations would be made in a future cultural landscape treatment plan. Generally, proposed plantings would include a formal garden consisting of flowers and a small fruit tree orchard adjacent to the western side of the house within the historic core.

DEER POPULATION MANAGEMENT ACTIONS

Under alternative C, various deer management actions would be used depending on the location. Across Fire Island, a combination of sharpshooting, capture and euthanasia, and a controlled public hunt (at the Fire Island Wilderness only) would be used to lower the deer density to approximately 20–25 deer per square mile. In the Fire Island communities, deer that approach humans would be captured and euthanized, contributing to the number of animals that need to be removed to meet the initial deer density target. Within the Sunken Forest, the sensitive maritime forest would be fenced, as described under alternative B, and all deer within the fence would be removed through direct methods (sharpshooting or capture and euthanasia). Finally, at the William Floyd Estate, direct reduction would be used to lower the deer density to approximately 20–25 deer per square mile. These actions are described below in more detail.

Sharpshooting

Sharpshooting would involve the use of professionals or skilled volunteers to remove deer within the Seashore in designated areas, generally using firearms. All sharpshooters would be held to rigorous skill and safety standards. Methods, removal numbers, and sex preferences are described below.

Methods. Qualified federal employees or contractors would be used to implement this action. They typically would be expected to work with Seashore staff to coordinate all details related to sharpshooting actions, such as setting up bait stations, locating deer, sharpshooting, and preparation of carcasses for disposal or donation. Disposition of the deer (donation of meat and

disposal of waste or carcasses) would be coordinated by Seashore staff (e.g., transportation to the meat processing facility and coordination with the meat recipient).

In most locations, high-power, small-caliber rifles would be used at close range. Nonlead ammunition would be used in this case to meet NPS policy (NPS 2009d). Use of nonlead ammunition also would serve to preserve the opportunity to donate the meat or to leave it in the field for scavenging wildlife without risking dissemination of lead into the food chain. Every effort would be made to ensure humane treatment of individual deer.

Sharpshooting would primarily occur at night (between dusk and dawn) during late fall and winter months, when deer are more visible and there are few visitors at the Seashore. In some restricted areas, sharpshooting may take place during the day, if needed. In this case, the areas would be closed to Seashore visitors. In both cases, qualified federal employees or contractors would be located in elevated positions (e.g., tree stands) or in clearly marked, high-clearance government vehicles traveling on trail roads on the Fire Island and within the William Floyd Estate. Spotlights would be used during night operations. The public would be notified of any Seashore closures and deer management activities in advance via media releases and alerts posted to the Seashore's website and social media venues; and with printed notification posted at Seashore visitor contact stations, Seashore bulletin boards, and public billboards located within the Fire Island communities. Visitor access would be limited as necessary during direct reductions, and NPS personnel would patrol public areas to ensure compliance with Seashore closures and public safety measures. During sharpshooting activities, noise-suppression devices and night vision equipment would be used to reduce disturbance to the public. Activities would be conducted in compliance with all federal firearm laws administered by the Bureau of Alcohol, Tobacco, Firearms, and Explosives.

Temporary bait stations could be used to attract deer to safe removal locations. The stations would be placed in Seashore-approved locations, away from public-use areas, to maximize the efficiency and safety of the direct reduction program. The amount of bait placed in any one location could range from 20–100 pounds, depending on the bait used and the number of deer in the immediate area (DeNicola et al. 1997b).

Training. Qualified federal employees or contractors with demonstrated expertise and training in the implementation of successful wildlife and deer management actions—including firearms handling, direct removal techniques, carcass processing, and wildlife capture and handling—would perform these activities. These individuals also would need to demonstrate firearms proficiency, based on NPS firearms qualifications, on an annual basis throughout the project. On-site training would include Seashore orientation and required safety measures to protect visitors, NPS employees, and volunteers. Volunteers would not be allowed to use firearms but may assist in other activities such as the transport and processing of carcasses, maintenance of bait stations, and implementation of Seashore closures. Volunteer training would be provided by NPS staff to support volunteer involvement.

Disposal. Deer carcasses would be transported by NPS staff and/or contractors to a central location for temporary storage during removal actions and collection of biological data. Deer removed off site would be transported by NPS staff and/or contractors on a daily basis for processing; more than one processing facility may be used. The meat from these deer would be provided directly from the meat processing facility to a local food bank or food pantry for the purpose of redistribution for human consumption. In situations where access to the carcass is difficult or not in a highly visible area, surface disposal may be acceptable. In these circumstances, every effort would be made to reduce the visibility of the carcass to Seashore visitors.

Number of Deer Removed. Seashore staff would determine the number of deer to be removed based on the most recent deer population survey and the initial deer density goal of approximately 20–25 deer per square mile, as well as past experience of other deer population reduction programs, technical feasibility, and success of forest regeneration in later years of plan implementation. Based on 2012 deer density reports for Fire Island and the experience with population reduction at other national park units such as Valley Forge National Historical Park, it is estimated that the desired deer density goal could be reached at Fire Island and the William Floyd Estate in 1–2 years if 65% of the population is initially targeted for removal. These estimates are based on the technical, financial, and logistic feasibility of removal at both locations. It is recognized that deer population reduction could proceed more rapidly if it is possible to remove more deer in each year and if the deer population growth is lower than anticipated.

Table 7 provides a likely scenario for the removal actions at each location, beginning with the 2012 deer population numbers. The scenario assumes that direct reduction methods would be used to remove the deer. Removal would be targeted for the six-month period from October through March. The extent to which the three methods of direct reduction would be used is dependent on variable factors (e.g., number of hunting permits issued, number of deer that would need to be euthanized, etc.) which would be established upon implementation of the plan and could vary by year.

As previously noted, several factors could influence the number of years required to reach the initial deer density goal. The numbers presented in table 7 are estimates based on 2012 deer density and estimates of annual growth, as well as what experienced staff believe is reasonable. These numbers could change over time when the plan is implemented. For example, as the deer population numbers decrease through successful direct reduction efforts, deer might become adapted to the direct reduction operations and become more evasive, increasing the effort necessary to reach the removal numbers in any year. Actual reproduction and mortality rates might differ from the estimates used in this projection. If reproduction rates were higher and mortality lower than estimated, the population growth would be greater, and more deer would need to be removed; this could increase the time to reach the initial density goal or call for a greater number of deer to be removed, if feasible given available resources. The converse would be true if reproduction rates were lower and mortality rates higher than estimated, resulting in removing fewer deer and reaching the deer density goal in less time. Immigration of deer into the Seashore property could also vary, and this would have an effect on the number of deer to be removed (Porter, Underwood, and Woodward 2004). Thus, monitoring would be an essential part of this alternative, and actions could be adjusted as described in the "Adaptive Management Approaches Included in the Alternatives" section.

The number of deer removed in years following attainment of the desired density goal would be adjusted as described in the "Adaptive Management Approaches Included in the Action Alternatives" section. This number may vary annually depending on the success of previous removal efforts, deer adaptations to removal efforts, vegetation regeneration response, and other factors. In general, at Fire Island the number of deer to be removed annually would range from 10–31, while at William Floyd Estate, it would range from 3–12.

The number of females in the deer population also would influence reproduction rates. Due to the preferential removal of females, as described below, recruitment into the population should decrease, because fewer females would be reproducing. However, as the habitat improves, reproductive rates may increase as well.

TABLE 7. ESTIMATED DEER REMOVALS BY YEAR AND LOCATION (ALTERNATIVE C)

Year	Total Number of Deer	Percent Removed	Number Removed	Post-Removal Number	Post-Removal Density (deer per square mile)	Reproduction	Immigration	Pre-removal Number for the Following Year
Fire Island (low end of population)								
1	194	65	126	68	17.3	10	0	78
Fire Island (high end of population)								
1	392	65	255	137	34.9	21	0	158
2	158	65	80	77	19.9	12	0	89
William Floyd Estate (low end of population)								
1	66	65	43	23	25.4	3	0	27
2	27	33	9	18	19.9			
William Floyd Estate (high end of population)								
1	141	65	92	49	54.2	7	0	57
2	57	65	37	20	22.1	3	0	23
3	23	22	5	18	19.9	3	0	21

Sex Preference. Focus on female deer is necessary to stabilize or reduce deer populations (DeNicola et al. 2000). However, due to the size of the deer population, during the first two years of direct reduction, both female and male deer across age classes would be removed based on opportunity. Thereafter, at least 15 females should be taken for every 10 males (WVU 1985). There would be a preference for removing females, because this would reduce the deer population level more efficiently over the long term.

Records would be kept on the herd composition (i.e., age and sex) of all deer removed from the Seashore to provide the Seashore with additional information on herd population metrics. This information would be compared with data used in deer population models to improve model accuracy.

Capture and Euthanasia

Capture and euthanasia would be used only in circumstances where sharpshooting would not be appropriate due to safety or security concerns, such as within the Fire Island communities or close to occupied buildings. For this reason, this method would be used on an estimated 15% or less of the total number of deer removed based on the experience of Seashore biologists conducting annual deer density counts who are familiar with the Seashore setting. Activities would occur when few people visiting the Seashore.

Captured deer would be euthanized as humanely as possible, in accordance with current veterinary recommendations such as those published by the American Veterinary Medical Association. Most capture methods involve using bait to attract deer to a specific area where deer could be darted with a tranquilizer (Schwartz et al. 1997) or captured using select trapping methods. Tranquilizing darts could also be used without bait stations when deer are within range of darting. The method of capture and euthanasia would be selected based on the specific circumstances (location, number of deer, accessibility, and reasons that sharpshooting was not advised). Animals euthanized with chemicals would be appropriately disposed of, and would not be available for consumption.

Qualified federal employees or contractors with demonstrated experience in direct (lethal) removal actions and training in the use of methods and tools associated with humane euthanasia (firearms and/or tranquilizer darts) would perform these actions. Training would include safety measures to

protect visitors, NPS employees, and contractors. Federal employees or contractors would also be qualified to handle live deer in order to minimize any harm to an animal or an employee. Appropriate safety measures would be followed when setting up the capture area.

Data would be collected on each deer removed by capture and euthanasia to include (at a minimum) age, weight, sex, location of removal, circumstance requiring removal and capture, and method used.

Public Hunting at the Fire Island Wilderness

A controlled public hunt would be carried out in the Fire Island Wilderness, abiding by the NYS-DEC hunting season and regulations. The Seashore would be responsible for managing the public hunt and may limit the number of hunters and the hours available for hunting. To protect vegetation at the Fire Island Wilderness, hunters would not be allowed to use vehicles. The use of both bowhunting and firearms could be allowed, as dictated by the state deer hunting seasons. At least one check station would be provided for the collection of biological data (i.e., sex and age), possibly near the Fire Island Wilderness visitor center. Gut piles may be left behind in the field for natural decomposition/scavenger use.

ALTERNATIVE D

Deer browsing management actions would include exclosure fencing in the Sunken Forest (approximately 44 acres of maritime holly forest), fencing of an area encompassing the historic core at the William Floyd Estate (approximately 80 acres), and small-scale fencing to protect special-status species. The deer population would be reduced to an appropriate deer density to achieve the plan objectives (estimated at 20–25 deer per square mile) through a combination of sharpshooting, capture and euthanasia of individual deer (where appropriate), and public hunting (within the Fire Island Wilderness only). Once reduced, the deer population could be maintained through fertility control in place of or to supplement use of direct reduction methods. Fertility control could be implemented using a chemical reproductive control agent when an acceptable agent becomes available. Until an acceptable and effective reproductive control agent becomes available, the deer population would be maintained using the same methods used for direct reduction as described above for alternative C. Deer observed approaching humans within the Fire Island communities would be captured and euthanized.

FENCING

Vegetation management actions under alternative D would vary depending on the location. Fencing of the Sunken Forest and small-scale fencing of special-status plant species island-wide would take place as described under alternative B. At the William Floyd Estate, fencing of the historic core area would occur as described for alternative B to protect from deer browse all plantings important to the cultural landscape. The layout of fencing at the William Floyd Estate is illustrated in figure 5.

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FIGURE 5
William Floyd Estate Proposed Fencing - Alternative D

DEER POPULATION MANAGEMENT ACTIONS

Direct Reduction

Under alternative D, the direct reduction methods described under alternative C would be implemented to quickly reduce the deer population to the initial density goal. These methods also may be used for deer population maintenance. For instance, if monitoring indicates that the reproductive control application has been ineffective in maintaining the deer population at the desired density or if an acceptable reproductive control agent is not available, these could be reasons for the continued use of direct reduction methods.

Reproductive Control

Reproductive control of female deer through the use of a chemical reproductive control agent also could be implemented (when an acceptable chemical agent becomes available) as described under alternative B to maintain the deer population after it has been reduced. Ideally, implementation would begin simultaneously with direct reduction. However, for the purposes of this analysis, it is estimated that the use of reproductive control could begin during the third year of population reduction, if an acceptable agent is available at that time (if an acceptable agent is not available, direct reduction methods would be used, as stated previously). The success of implementing reproductive control on a deer population that has undergone reduction efforts for several years would depend on advances in reproductive control agents, sensitivity of the deer population to humans, methods used by the qualified federal employees or contractors, changes in immigration with reduced deer density, and general deer movement behavior (Porter, Underwood, and Woodward 2004; Naugle et al. 2002). It should be expected that getting close enough to administer remote injections would become increasingly difficult after reduction efforts due to deer behavioral changes in response to previous human interaction (Underwood 2005).

Assuming reproductive control was initiated when the Seashore's deer population density reached the range of 20–25 deer per square mile, the Seashore's total deer population would be no more than 220 animals on Fire Island and 24 animals at the William Floyd Estate. Assuming that the sex ratio composition of the reduced deer population was approximately 50:50 based on selective targeting of females during direct reduction, there would be approximately 122 females in the population. For the initial fertility control treatment, the estimated number of adult females that may need to be treated and marked for identification would be 110 individuals, or 90% of the females. The deer population would be monitored as fertility control continues in subsequent years, and uncertainties could be tested via modeling approaches as part of adaptive management. If the deer population increased during the reproductive control application under this alternative, periodic direct reduction methods could be initiated to maintain the deer population density at the identified goal.

ADAPTIVE MANAGEMENT APPROACHES INCLUDED IN THE ACTION ALTERNATIVES

All of the action alternatives (alternatives B, C, and D) described in this chapter incorporate adaptive management approaches to meeting the objectives of the plan. Each alternative includes a management action followed by a period of monitoring to evaluate the results of the action. By using an adaptive management approach, managers would be able to change the timing or intensity of management treatments to better meet the goals of the plan as new information is obtained. The adaptive management approach and its integration into the action alternatives are more fully described below.

Successful management of natural systems is a challenging and complicated undertaking. All USDI bureaus are encouraged to "use adaptive management to fully comply" with the Council on Environmental Quality's guidance that requires "a monitoring and enforcement program to be adopted . . . where applicable, for any mitigation" (516 DM 1.3 D (7); 40 CFR 1505.2). In addition, USDI has outlined the adaptive management approach in a technical guide developed to provide guidance to all USDI bureaus and agencies (Williams, Szara, and Shapiro 2007).

Adaptive management is based on the assumption that current resources and scientific knowledge are limited. Nevertheless, an adaptive management approach attempts to apply available resources and knowledge and adjusts management techniques as new information is revealed. Holling (1978) first described the principle of adaptive management as requiring management decisions and policies to be viewed as hypotheses change.

USING THE ADAPTIVE MANAGEMENT PROCESS

Adaptive management is a systematic approach for improving resource management by learning from management outcomes (Sexton et al. 1999). An adaptive approach involves exploring ways to meet management objectives, predicting the outcomes of alternatives based on the current state of knowledge, implementing one or more of these alternatives, monitoring to learn about the impacts of management actions, and then using the results to update knowledge and adjust management actions (Murray and Marmorek 2004). Adaptive management focuses on learning and adapting, through partnerships of managers, scientists, and other stakeholders, who learn together how to create and maintain sustainable resource systems (Bormann et al. 2006).

Under the approach outlined by USDI guidance, adaptive management should be used when decisions must be made despite uncertainty and there is a commitment to using this approach. The deer management situation at Fire Island National Seashore meets all of these conditions.

There are two phases involved in a successful adaptive management plan: the set-up phase and the iterative phase. The set-up phase was completed concurrently with the development of this plan/EIS. The iterative phase would commence with the implementation of an action. Adaptive management approaches that would be included in the iterative phase are described below.

ADAPTIVE MANAGEMENT APPROACH

Under this plan/EIS, the following five steps would constitute the iterative phase of the adaptive management approach. For illustrative purposes, alternative D is used as an example for each of these steps.

1. Monitor the conditions. These conditions would be recorded and compared against baseline data to determine whether management actions are necessary. For much of the Seashore, baseline data already exist. Seashore staff are currently expanding monitoring efforts to gather additional data in areas where data on baseline conditions does not exist.
2. Apply the management action. Deer would be managed using an action alternative described in this document; for example, alternative D could initiate removal of deer to lower the deer population and reproductive control to maintain the deer density at the desired target range when an agent was available and met the criteria established in this plan/EIS. Initial thresholds for taking action for the various areas of the Seashore have been established, as described under the "Thresholds for Taking Action" section in chapter 1, and these thresholds will be adjusted if necessary in the future.

3. Monitor for the effectiveness of each management action. Monitoring would determine whether the management actions were achieving the desired outcome. For example, is there a reduction in the number of human-deer contacts within the Fire Island communities, or is forest regeneration occurring in the lower acreage of the William Floyd Estate as the initial deer density goal is achieved? Is reproductive control maintaining the deer population within the targeted deer density range?
4. If monitoring indicates that the goal of forest regeneration is not at an adequate level because of deer browsing pressure, reconsider the management actions. For example, under alternative D, this could result in establishing a lower deer density goal and using a combination of removal methods to reduce the population to achieve the new density.
5. If the management action is effective, and the forest is regenerating, consider modifications to the intensity of the action. For example, if forest regeneration is successfully occurring, consider whether deer density be raised (i.e., remove fewer deer) while still producing the same effect.

The adaptive management approach would be used in the following areas.

Undesirable Human-Deer Interactions

The plan incorporates several tools to reduce undesirable human-deer interactions. Methods of education/interpretation and coordination with community officials and boards, landowners, and vacationers will be important to the success of the plan. The Seashore would establish methods for reaching out to the Fire Island communities, and results of the education/interpretation efforts would be monitored via direct communication with visitors, questionnaires/surveys, and observations of direct feeding of deer and exposed garbage during deer distance sampling counts. It would take time for the Seashore's efforts at education/interpretation to effectively change the human behaviors that promote undesirable human-deer interactions. Modifications to actions would be based on these monitored results over time and compared to baseline conditions. Adjustments may be required in communication techniques such as the use of social media sites, printed materials, and public hearings. If the Seashore experiences little decrease in feeding of deer by the public, and deer are continuously feeding in exposed garbage, the Seashore would investigate additional methods for public outreach.

In addition, actions would be required to remove deer that approach humans. It is expected that decreases in negative human-deer interactions would occur within the second year after the majority of those deer (as observed during monitoring) are removed. The Seashore would annually monitor the deer population to determine the estimated deer density and to observe deer behavior. In the initial years of the plan, the goal would be to observe fewer deer approaching biologists during monitoring compared to the previous year. As described in the thresholds for taking action, the Seashore expects the percentage of deer observed to approach Seashore biologists is expected to approach 3%. As those deer observed approaching humans are removed, the Seashore expects a point in time when either all the deer approaching humans have been removed or at least the number of deer between years does not differ. If removal of deer that approach humans does not reduce the incidence of human-deer interactions, additional actions could be developed to manage other factors which encourage human-deer interactions.

Vegetation Management

Actions are needed to improve vegetation conditions within the Sunken Forest, other maritime forests, and the William Floyd Estate. The action thresholds differ for each area, and the proposed actions could be modified based on the best available data for forest regeneration, results of monitoring plot data, and deer density changes. The Seashore expects little changes in planned actions would be needed for the Sunken Forest since all deer would be removed within a protected

fenced area. Nonetheless, monitoring data would be compared with expectations (that herbaceous and woody vegetation would increase as deer density decreased) for each of the other areas of the Seashore. Other influences would also be considered in an adaptive management program to include climate change and the spread of invasive species. It is expected that it would take at least eight to 10 years after the initial deer density goal was achieved until vegetation results would be seen in the monitored plots within the maritime forests and the William Floyd Estate. If results after 10 years did not meet the objectives and goals of the plan, or ongoing monitoring indicated that there were other factors limiting forest regeneration, adjustments would be made to the existing vegetation management. These adjustments could include manipulation of forest canopies to control sunlight, artificial plantings, nonnative species management, or responses to the effects of climate change. Canopy treatments would be used if it were determined that the existing forest structure was preventing sunlight from reaching new seedlings. Enhanced nonnative species management may also be needed to promote forest regeneration and reduce competition. Finally, as the science and effects related to climate change become clearer, the Seashore may modify its vegetation management to continue to promote vegetation recovery in the changing climate.

The Seashore has extensive data on vegetation within the Sunken Forest, dating as far back as 1967. This data gives the Seashore a glimpse of the condition of the Sunken Forest before the irruption of the deer population, which is important at establishing targets. Once the Sunken Forest is protected from deer via fencing, monitoring within established vegetation plots would determine the success of the plan. If targeted vegetative species are not present after 8–10 years, the Seashore may consider more adaptive management approaches such as planting new stems, manipulating canopy openings, removing undesirable species (such as black cherry), or controlling heavy vine cover to promote preferred species.

Deer Density Goal

The number of deer to be removed annually throughout Fire Island and at the William Floyd Estate would be adjusted based on the results of the previous year's removal effort, the monitoring of forest regeneration, deer population surveys, and deer population growth projections. The approximate number of deer to be removed would be defined by the difference between the estimated deer population density and the initial density goal selected (e.g., 20–25 deer per square mile). This density goal would be achieved within two years, after which annual removal objectives would be based on the number of deer remaining in the population after each year's removal actions and factoring in an annual growth rate in order to maintain the population at the target level. This process of determining the number of deer to be removed would be repeated each year.

A primary objective of this plan is to achieve the successful regeneration of vegetation at the Seashore. Thus, vegetation monitoring results would be the key parameter for determining success, and not deer density. If monitoring indicated that vegetation was not regenerating, management actions would be adjusted. The following are examples of how this adaptive management approach could be implemented based on different outcomes:

- If vegetation regeneration is observed prior to meeting the initial deer density goal, the initial deer density target may be adjusted upward to the density that would still allow regeneration to occur.
- If the initial deer density goal of 20–25 deer per square mile was not reached within the first six years of the plan, additional efforts may be made to reach the desired density through the use of other methods of removal, such as increasing the use of capture and euthanasia in areas where sharpshooting was not effective.
- If vegetation regeneration proved to be insufficient within eight to 10 years after the initial deer density goal was reached, then the deer density goal could be lowered by five

additional deer per square mile, with a 6-year monitoring period before further reductions were made in density goals.

- In addition, if insufficient vegetation regeneration occurred after the deer density goal was reached, methods and protocols would be reviewed to identify the variables that were limiting expected results, and the methods used may be adjusted as necessary to correct for such factors.

Reproductive Control

Using alternative D as an example, reproductive control via a chemical reproductive control agent is one of the proposed measures to maintain the deer density once the target density was reached via direct reduction. The Seashore has gained knowledge and experience at controlling deer numbers using contraception from a multiyear study on the Fire Island. However, questions remain regarding its effectiveness as a tool for long-term management of deer at the Seashore. As the need for deer management methods increases, additional agents could be developed and tested for reproductive control on free-ranging deer. The Seashore could review the science at that time to determine if other agents are appropriate for the Seashore. The size, scale, and location of the application would depend on the specifications and efficacy of the drug. Furthermore, success of reproductive control using a contraceptive agent is dependent on the Seashore's methods and skill to capture animals for administering the chemical agent. The Seashore may find that modifications in capturing techniques would be needed to increase success.

Implementing Elements of the Plan/EIS

A number of the elements of the plan/EIS are based on recent vegetation monitoring, the current deer density at the Seashore, existing technology, and knowledge of deer population dynamics. As the plan/EIS is implemented, it is assumed that knowledge and experience with these issues would increase at the Seashore, within the state, and across the National Park Service. Improved knowledge and experience may result in adjustments being made to the timing of direct reduction, the implementation of reproductive controls, or any of the other elements included in the plan/EIS. Changes in timing would be made in cooperation with the state and only when there was scientific evidence to support such an action.

ALTERNATIVE ELEMENTS CONSIDERED BUT DISMISSED

The following alternative elements were considered but dismissed from further detailed analysis as explained below.

CAPTURE AND RELOCATION OFF OF FIRE ISLAND

Live-capture and relocation as an alternative may have limited success in controlling a small, isolated population, or in removing animals from one area to augment populations in other areas where the deer population is below desired levels (Coffey and Johnston 1997). Whereas translocation of deer on the same property would be allowed by New York State, state regulations do not support capture and relocation of white-tailed deer between separate land parcels within the state. Therefore, capture of deer on Fire Island for relocation on Long Island was dismissed as a management option.

REVERSING DEER BEHAVIOR TO REDUCE UNDESIRABLE HUMAN-DEER INTERACTIONS

The science team evaluated potential actions that could possibly reverse the behavior of those deer most habituated to the human presence (i.e., aversive conditioning) in an effort to reduce undesirable human-deer interactions. To change actual deer behavior, scientists believe that deer would need to have dramatic negative experiences in order to break their habituation. Suggested actions were discussed, such as cues of predators, hunting, dispersal of negative scents, visual or audible devices, or the use of dogs to chase deer, but these actions are impractical on private lands within the Fire Island communities. Scientists believe direct negative human interactions that provide deer the fear of harm, termed as "hazing," would be the only approach that may change deer behavior, but the likelihood of success is very low in the scientists' opinion. Deer movements or behavioral patterns are difficult to modify once they have been established (DeNicola et al. 2000). Furthermore, hazing would need to be consistent, around the clock, and perpetual, which is problematic because it would require participation by all humans, even non-Seashore individuals, which is unrealistic as part of a NPS deer management plan. For these reasons, aversive conditioning of deer at the Seashore was dismissed from further consideration.

SURGICAL STERILIZATION

Surgical sterilization of females is an effective method of controlling reproduction and has been used extensively in domestic animal medicine. However, implementation requires capture, general anesthesia, and surgery conducted by a veterinarian, which is generally considered labor intensive and costly (Boulanger, et al. 2012) and calls into question the long-term sustainability of sterilization as a wildlife management tool, except under very limited circumstances. Boulanger and others (2012) note that surgical sterilization is a costly but effective technique for reducing suburban deer herds if 80% or more of the female deer in a population are sterilized and that proportion is maintained over time. Overall success was greatest for closed populations. Only in rare circumstances is physical sterilization reversible.

Depending on the method of sterilization, this procedure may have behavioral effects on both male and female deer. If gonads are removed, then the source of important reproductive hormones would be removed. This is likely to change deer social interactions. If gonads are not removed, females would continue to ovulate and show behavioral signs of estrus and consequently may extend the breeding season.

This option would involve administering a tranquilizing agent to female deer via dart by qualified personnel. Once the tranquilizing agent had taken effect, surgery in the field would be performed by a qualified veterinarian to remove or disconnect select reproductive organs, affecting permanent infertility. Overall, this option would take a substantial amount of time per deer. When compared to the alternatives considered in this document and the number of deer that would need to be treated surgical sterilization is technically unfeasible as a stand-alone alternative. Based on these reasons, surgical reproductive control was dismissed as a management option.

The potential use of surgical sterilization in combination with other deer population management actions was also reviewed. Discussion focused on the potential number of deer that would require treatment; the length of time required to achieve the deer density goal if implemented in combination with direct reduction; mortality of treated females; available research on population level effects particularly for large, free-ranging deer populations; baseline data on Seashore deer required to fully develop a combined alternative involving surgical sterilization; and potential implications of using a nonreversible management action. Surgical reproductive control was

dismissed as an element of a combined alternative because there is little available research on population level effects. Therefore, the use of an irreversible management action based on population parameters that could potentially change greatly in the future was not recommended.

SUPPLEMENTAL FEEDING

Providing supplemental food to deer is often suggested as a way of reducing damage to natural or ornamental vegetation. However, the NPS *Management Policies 2006*, section 4.4.1, "General Principles for Managing Biological Resources," and section 4.4.2, "Management of Native Plants and Animals," are aimed at allowing natural processes to occur whenever possible (NPS 2006a) and would not support supplemental feeding. For this reason, the use of supplemental feeding was dismissed as a management option.

PREDATOR REINTRODUCTION

Relationships between predators and prey are complex, and the impact of predators on herbivore populations is variable (McCullough 1979). Coyotes (*Canis latrans*) are deer predators present throughout much of North America but are currently not found in or near the Seashore. However, this species appears to be opportunistic, taking advantage of specific periods of deer vulnerability and has not demonstrated a consistent ability to control deer populations. Even though coyote populations have increased and the coyote's range has expanded over the past 20 years, both deer and coyote populations have increased simultaneously in many areas (NYS-DEC and CCE 1991). Biologists believe that coyotes are partly responsible for declining deer numbers in some areas, but changes in deer populations in other areas appear unrelated to coyote density. Coyotes hunt individually and are territorial, so large deer are generally not taken by individual coyotes. Wolves are efficient deer predators, but they have been eliminated from much of the United States. Introducing wolves to the Seashore is not feasible due to a lack of suitable habitat. Wolves have home ranges averaging 30 square miles when deer are the primary prey (Mech 1990), which is much larger than the Seashore's 8.8 square miles. Also, most of the Seashore is surrounded by, or includes, an urban or suburban environment, in particular at the William Floyd Estate and in the Fire Island communities, making it impractical for predators such as wolves or coyotes to be reintroduced. There are issues with possible adverse effects on residents, especially the safety of pets and children.

Due to reasons described above relating to effectiveness, habitat limitations, and human safety concerns, the use of predators to manage the deer population was dismissed from further analysis.

REPELLENTS, PLANTINGS, AND OTHER DETERRENTS

Chemical repellents and the selection of plants that are not palatable to deer are good options for individual homeowners to discourage deer from destroying residential yards and gardens. These repellents can be sprayed on or attached to nearby vegetation, thus protecting individual plants or larger areas (Coffey and Johnston 1997). However, repellents are removed by rainfall, requiring repeated applications. At high deer densities, repellents may be completely ineffective (Maryland DNR 2002). Therefore, it would be impractical to effectively manage deer through the use of repellents in a large park setting. Visual and sound deterrents also are available to scare deer away from areas (API 2000). However, visual and sound deterrents and planting of unpalatable plants would be impractical in a large park setting and could have impacts on visitor experience. Therefore, using repellents, select plantings, and other deterrents was dismissed as a management option.

CONSISTENCY WITH SECTIONS 101(B) AND 102(1) OF THE NATIONAL ENVIRONMENTAL POLICY ACT

Council on Environmental Quality (CEQ) regulations (40 CFR 1500.2) require that the EIS include an analysis of how each alternative meets or achieves the purposes of NEPA, as stated in sections 101(b) and 102(1). This section describes how each of the alternatives under consideration in this plan/EIS meets or achieves these policies.

1. Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
2. Ensure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings.
3. Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.
4. Preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice.
5. Achieve a balance between population and resource use that would permit high standards of living and a wide sharing of life's amenities.
6. Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

ALTERNATIVE A (NO ACTION)

Alternative A would meet the purpose of NEPA to some extent because limited protection of certain rare species and habitats would be continued. Under alternative A, the Seashore would continue to attain a wide array of beneficial uses (criterion 3), although there would be continued degradation of natural and cultural resources. Damage to vegetation, unique vegetation communities, and special-status plant species; white-tailed deer population; other wildlife and wildlife habitat; wilderness; cultural landscapes; Fire Island communities and adjacent landowners; public health and safety; and Seashore operations would continue, as a result of excessive browsing by high numbers of deer. The continued degradation of natural features and cultural landscapes would not maintain a balance between the deer population and the surrounding resources (criterion 5). Additionally, this alternative would neither fulfill the responsibilities of each generation as the trustee of the environment for succeeding generations nor preserve important aspects of our national heritage (criteria 1 and 4, respectively), because of the degradation of natural features and cultural landscapes. Alternative A would not enhance the quality of renewable vegetation resources (criterion 6). The expected adverse impacts would not ensure healthful, productive, or esthetically pleasing surroundings (criterion 2).

ALTERNATIVE B

This alternative would meet some of the criteria within the life of the plan, primarily in the latter years, as fencing and reproductive controls took effect. Members of the planning team noted that the fencing would protect part of the environment without requiring the reduction of the deer population. However, it would provide only limited direct protection for vegetation, unique vegetation communities, and special-status species. This alternative would also rely heavily on a technology (fertility control) that might not be available for a number of years. The gradual progress this alternative provides would not fully achieve all six criteria. In particular, the exclosures would detract from esthetics of the cultural landscapes (criterion 2), and reproductive control methods

could have other unintended consequences. The installation and movement of fencing could result in additional damage of resources (e.g., wetlands), an undesirable consequence (criterion 3). Alternative B also raises concern about unintended consequences (criterion 3) because it would rely on technology (fertility control) that has not been proven in free-ranging deer as a population management tool. Fencing would not limit the choices available to the public (criterion 4) because access to the William Floyd Estate and to the trails within the Sunken Forest would be provided through gates in the fences. The lack of protection for a large percentage of the Seashore, and the time it would take any reproductive control to be effective, would mean that succeeding generations might not see desired results for some time (criterion 1). Incorporating adaptive management principles would help achieve some balance between population and resource use (criterion 5), but the limited history of reproductive control success and the limits on how much vegetation would be included in exclosures means that it would not be possible to completely approach the maximum attainable recycling of resources (criterion 6).

ALTERNATIVE C

Alternative C would succeed in meeting all of the criteria within the life of the plan. By immediately reducing deer browsing pressure, this alternative would allow vegetation in the Seashore to regenerate for the benefit of future generations faster than alternative B (criterion 1). The immediate reduction in the deer population and subsequent improvements in the natural environment would provide a great deal of benefit. There would be some safety concerns associated with direct reduction methods used to implement alternative C; however, by implementing proper controls, these concerns could be minimized. The result would be safer conditions throughout the Seashore and Fire Island communities because of lower incidence of human-deer interactions. However, the small-scale fencing would detract from esthetics of the cultural landscapes (criterion 2). Alternative C would require temporary closures of some areas of the Seashore during direct reduction implementation, which would limit the use of these areas. However, these closures would occur at times and places that are not high visitation periods and would take place to maximize public safety. This alternative would avoid undesirable conditions by immediately reducing deer browsing. Alternative C would avoid unintended consequences associated with direct reduction actions through implementing regular Seashore closures, scheduled closures of certain areas of the Seashore, and public outreach and communication (criterion 3). The closures within the Seashore would limit individual choice, but only for limited periods. These closures would allow for the reduction of the deer population, which would protect the Seashore's natural and cultural resources and provide greater choices in the future (criterion 4). This alternative also would achieve a balance between the deer population and the surrounding Seashore resources (criterion 5). Finally, by immediately reducing the deer browsing pressure and promoting forest regeneration, this alternative would enhance the quality of renewable resources (criterion 6).

ALTERNATIVE D

Alternative D is similar to alternative C in the extent to which it would meet the intent of NEPA. The evaluation of these alternatives shows that both would fulfill the responsibilities of each generation as a trustee of the environment for succeeding generations (criterion 1) to a large degree because both would immediately reduce deer numbers, thereby reducing browsing pressure and promoting regeneration. The exclosures would detract from esthetics of the cultural landscapes (criterion 2). Both alternatives also would help achieve a balance between population and resource use (criterion 5). Although they may approach the criteria in a slightly different manner, both alternatives would approach the maximum attainable regeneration of depletable resources (i.e., vegetation) by reducing and maintaining the deer population density (criterion 6). Implementation of alternative D would

avoid unintended consequences (criterion 3) associated with direct reduction actions through implementing regular Seashore closures, scheduled closures of certain areas of the Seashore, and public outreach and communication, and could cause some concern about unintended consequences because it would use technology that has not been proven in free-ranging deer as a maintenance tool. Risks to health and safety (criterion 3) associated with the reproductive control method would be less than alternative B because fewer deer would be treated with a fertility control agent. Although the planning team recognized the uncertainties associated with reproductive control agents, it was recognized that this technology is developing rapidly and would provide additional information in the near future. Any safety concerns would be reduced through proper safety controls. Finally, alternatives C and D both would preserve important historic, cultural, and natural aspects of the Seashore in the long term (criterion 4), because the smaller deer population would reduce browse pressure on vegetation in natural areas, the Fire Island Wilderness, and the cultural landscapes at William Floyd Estate.

ENVIRONMENTALLY PREFERABLE ALTERNATIVE

In accordance with the Director's Order 12 Handbook, the National Park Service identifies the environmentally preferable alternative in its NEPA documents for public review and comment (section 4.5 E[9]). The environmentally preferable alternative is the alternative that causes the least damage to the biological and physical environment and best protects, preserves, and enhances historical, cultural, and natural resources. The environmentally preferable alternative is identified upon consideration and weighing by the responsible official of long-term environmental impacts against short-term impacts in evaluating what is the best protection of these resources. In some situations, such as when different alternatives impact different resources to different degrees, there may be more than one environmentally preferable alternative (43 CFR 46.30).

Based on the analysis of environmental consequences of each alternative presented in chapter 4 and summarized in table 9 below, alternative C has been identified as the environmentally preferable alternative because it is the alternative that would best protect the biological and physical environment by ensuring an immediate reduction in deer population, thereby reducing browsing pressure and promoting regeneration over the life of the plan. Alternatives C and D would best protect, preserve, and enhance the historic, cultural, and natural processes that support the Seashore's cultural landscape and vegetation through various management options to maintain low deer numbers. Although alternatives C and D are very close in meeting the goal that identifies the environmentally preferable alternative, alternative C was identified as the environmentally preferable alternative primarily because it would reduce the deer population using a method which has proven effective.

NPS PREFERRED ALTERNATIVE

The preferred alternative is the alternative which would fulfill the National Park Service's statutory mission and responsibilities (CEQ 1981). The preferred alternative was identified with consideration to the likelihood of meeting the objectives, flexibility and management options available for use in order to meet the objectives, timeframe in which desired conditions would be met, public concerns regarding safety and resource management, and feasibility of implementing the plan given uncertain economic conditions. The NPS has identified alternative D as the agency preferred alternative because immediate reduction of the deer population would provide the greatest protection of the Seashore's resources while imposing a minimal risk during implementation of carefully managed direct reduction actions. Additionally, under this alternative, Seashore managers would have the widest range of options available for the purpose of managing both deer browse and the deer population levels (i.e., fencing, direct reduction, and/or fertility

control). Having this flexibility would allow Seashore managers to implement whichever methods best balance resource protection with public safety and the level of effort needed for Seashore staff to implement the management activities.

HOW ALTERNATIVES MEET OBJECTIVES

As stated in chapter 1, all action alternatives selected for analysis meet all objectives to a large degree. The action alternatives must also address the stated purpose of taking action and resolve the need for action; therefore, the alternatives were individually assessed in light of how well they would meet the objectives for this plan/EIS, which are listed in chapter 1 of this document. Alternatives that did not meet the objectives were not analyzed further (see the section "Alternative Elements Considered but Dismissed" previously in this chapter).

Table 4 compares the alternatives by summarizing the elements being considered, while table 8 compares how each of the alternatives described in this chapter would meet the plan objectives. "Chapter 4: Environmental Consequences" describes the effects of each alternative on each impact topic. These impacts are summarized in table 9. The significance of the impacts is described in chapter 4 and summarized in table ES-1.

TABLE 8. HOW ALTERNATIVES MEET OBJECTIVES

Objective	Alternative A (No Action)	Alternative B	Alternative C	Alternative D (NPS Preferred)
Manage a viable white-tailed deer population in the Seashore that is supportive of the other objectives for this plan/EIS.	Does not meet the objective. No actions would be taken to manage the white-tailed deer population.	Meets the objective. Manages the white-tailed deer population in a way that would support other objectives following a relatively long period (approximately 13 years) to achieve deer density targets.	Meets the objective. Manages the white-tailed deer population in a way that would support other objectives relatively quickly, reaching desired deer densities targets after approximately 3 years.	Meets the objective. Same as alternative C.
Promote natural regeneration of native vegetation.	Does not meet the objective. No reduction in deer browsing pressure, resulting in inhibition of natural regeneration.	Meets the objective. Fencing of the Sunken Forest and rotational fencing at the William Floyd Estate would offer immediate protection from deer browsing pressures in those exclosures. Deer browsing pressures would be reduced throughout the rest of the Seashore, promoting natural regeneration after the initial 13 years of fertility treatment.	Meets the objective. Combined direct reduction actions would directly reduce browsing pressure, promoting natural regeneration after approximately 3 years.	Meets the objective. Same as alternative C.
Protect special-status species/vegetation communities and their habitat from high levels of deer browsing.	Does not meet objective. Although the Seashore currently fences individual special-status species plants when discovered, no plan would be implemented to reduce the deer browsing pressures from the communities as a whole.	Meets the objective. Fencing of the Sunken Forest and rotational fencing at the William Floyd Estate would offer immediate protection for special-status species/vegetation communities and their habitat from deer browsing pressures in those exclosures. Deer browsing pressures would be reduced throughout the rest of the Seashore, promoting natural regeneration after the initial 13 years of fertility treatment.	Meets the objective. Combined direct reduction actions would directly reduce browsing pressure on special-status species/vegetation communities and their habitat, promoting natural regeneration after approximately 3 years.	Meets the objective. Same as alternative C.
Work collaboratively with other land management agencies on issues associated with abundance, distribution, and behavior of white-tailed deer at the Seashore.	Does not meet objective. While the Seashore would continue general collaboration with other land management agencies, there would be no comprehensive plan in place to address issues associated with abundance, distribution, and behavior of white-tailed deer at the Seashore.	Meets the objective. Seashore staff would implement enhanced education/interpretation efforts as part of a comprehensive deer management plan in collaboration with other land management to address issues associated with abundance, distribution, and behavior of white-tailed deer at the Seashore.	Meets the objective. Same as alternative B.	Meets the objective. Same as alternative B.
Improve public understanding of the issues such as human-deer interactions, the impact of white-tailed deer on the cultural and natural resources of the Seashore, and tick-borne diseases throughout the Seashore, including the William Floyd Estate.	Does not meet objective. The Seashore would not implement a comprehensive education/interpretation effort to improve public understanding of the issues such as human-deer interactions, the impact of white-tailed deer on the cultural and natural resources of the Seashore, and tick-borne diseases throughout the Seashore, including the William Floyd Estate.	Meets the objective. Seashore staff would implement enhanced education/interpretation efforts to improve public understanding of the issues such as human-deer interactions, the impact of white-tailed deer on the cultural and natural resources of the Seashore, and tick-borne diseases throughout the Seashore, including the William Floyd Estate.	Meets the objective. Same as alternative B.	Meets the objective. Same as alternative B.
Continue to expand the knowledge base regarding the relationship between deer browsing and plant communities at Fire Island National Seashore to improve management decisions.	Partially meets the objective. The Seashore would continue current deer and plant monitoring efforts.	Meets the objective. Current deer and plant monitoring efforts would be enhanced as part of the plan to expand the knowledge base regarding the relationship between deer browsing and plant communities at the Seashore.	Meets the objective. Same as alternative B.	Meets the objective. Same as alternative B.

TABLE 8. HOW ALTERNATIVES MEET OBJECTIVES (CONT'D)

Objective	Alternative A (No Action)	Alternative B	Alternative C	Alternative D (NPS Preferred)
Within the Sunken Forest, maintain the character of the globally rare maritime holly forest by creating conditions for the regeneration of key canopy constituent tree species and a reasonable representation (as defined in the desired conditions description below) of herbs and shrubs that made up the Sunken Forest's vegetative composition when the Seashore was established.	Does not meet objective. Deer browse pressure would continue to inhibit regeneration of vegetation within the Sunken Forest's globally rare maritime holly forest.	Meets the objective. Deer would be excluded from the Sunken Forest to eliminate browsing pressure that could inhibit regeneration of vegetation within the Sunken Forest's globally rare maritime holly forest.	Meets the objective. Same as alternative B.	Meets the objective. Same as alternative B.
Reduce the potential for undesirable human-deer interactions both within the Fire Island communities and at other developed areas of the Seashore.	Does not meet objective. No comprehensive program would be implemented to reduce the potential for undesirable human-deer interactions within Fire Island communities and at other developed areas of the Seashore.	Meets the objective. The Seashore would reduce the potential for undesirable human-deer interactions through the implementation of enhanced education/interpretation within the Fire Island communities and at other developed areas of the Seashore. Additionally, the Seashore would reduce this potential through reduction of the local deer population over approximately 13 years.	Meets the objective. Same as alternative B, except that the deer population would be reduced more rapidly, over a 2-year period.	Meets the objective. Same as alternative C.
Manage deer browse to allow for the restoration and preservation of the cultural landscape of the William Floyd Estate and for the regeneration of the forest within the lower acreage of the William Floyd Estate.	Does not meet the objective. The current level of deer management does not reduce deer browse at sufficient levels to allow for the restoration and preservation of the cultural landscape of the William Floyd Estate and for the regeneration of the forest within the lower acreage of the William Floyd Estate.	Meets the objective. Deer browse would be reduced immediately through the use of fencing and would otherwise be reduced over approximately 13 years, allowing for the restoration and preservation of the cultural landscape of the William Floyd Estate and for the regeneration of the forest within the lower acreage of the William Floyd Estate.	Meets the objective. Deer browse would be rapidly reduced over a 2-year period, allowing for the restoration and preservation of the cultural landscape of the William Floyd Estate and for the regeneration of the forest within the lower acreage of the William Floyd Estate	Meets the objective. Same as alternative C.

TABLE 9. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A (No-action)	Alternative B	Alternative C	Alternative D
Vegetation, Unique Vegetation Community, and Special-status Species	**Fire Island Natural Areas** ▪ Existing deer population would not be reduced, causing continued high levels of deer browse island-wide. ▪ Browsing pressure would lead to a lack of forest regeneration, low survivorship of herbaceous plants, and the eventual dominance of unpreferred and browse-resistant plants, several of which are nonnative. ▪ Heavy deer browse would continue to alter understory species composition and densities within maritime forests. **Sunken Forest** ▪ Species composition would change over time to species not preferred by deer, such as black cherry. Eventual loss of oak-hickory community type could occur over time. ▪ Native seedlings positioned to replace canopy stems would continue to be impacted by heavy deer browse. ▪ Native plant constituents present in the 1960s would be locally extirpated within the Sunken Forest. ▪ Goals for managing vegetation at the Sunken Forest as mandated by enabling legislation would not be achieved over the long term. **William Floyd Estate** ▪ Continued high level of deer browse would impact forests' ability to regenerate native overstory species due to understory shifts in species composition caused by deer browse. **Special-status Species** ▪ Special status species susceptible to deer browse and trampling with no control of deer numbers. ▪ Continued seasonal fencing of special-status species from deer would benefit these plants	**Fire Island Natural Areas** ▪ Gradual reduction in deer density across the island would reduce browsing pressures on native vegetation. Reduction to initial target density would require up to 13 years. ▪ Vegetation is expected to recover from current browse levels approximately 8 to 10 years following deer population reduction. Therefore, vegetation recovery would require up to 23 years to be fully realized. ▪ If an acceptable fertility control agent is not available for up to 10 years following implementation of this plan, vegetation recovery would require up to 33 years to be fully realized. ▪ Reduced deer browse on understory herbs, shrubs, and seedlings in maritime forests. ▪ Translocation of deer may cause a localized increase in deer browse of native vegetation at the Fire Island Wilderness until the deer density is lowered. **Sunken Forest** ▪ Deer exclusion from this area would remove deer browsing pressures native seedlings, allowing for recovery of understory vegetation. ▪ Vegetation would be removed and/or relocated during installation of fencing, totaling 7,130 LF or 1.31 acres. ▪ Vegetation could be trampled during the deer drive to remove deer from the fenced area. ▪ Vegetation monitoring and implementation of adaptive management would benefit vegetation due to growing understanding and knowledge of the rare holly maritime forest ecosystem. **William Floyd Estate** ▪ Vegetation would be removed and/or relocated during installation of fencing (rotational fencing and core fencing) totaling 30,300 LF or 5.6 acres. ▪ Forest understory vegetation would recover with exclosure fencing. ▪ Exclusion of deer from fenced areas would cause higher browse pressure in surrounding areas until the overall deer density is reduced. **Special-status Species** ▪ Translocation of deer to the Fire Island Wilderness may cause a localized increase in deer browse of special-status species until the deer density is lowered; however, impacts would continue to be mitigated through use of fencing.	**Fire Island Natural Areas** ▪ Rapid reduction in deer density across the island would reduce browsing pressures on native vegetation. Reduction to initial target density would require approximately two years. ▪ As under alternative B, vegetation is expected to recover from current browse levels approximately 8 to 10 years following deer population reduction. Therefore, under alternative C, vegetation recovery would require up to 12 years to be fully realized. ▪ Other impacts on vegetation would be the same as described under alternative B but on the accelerated timeline described above. **Sunken Forest** ▪ Same as alternative B. **William Floyd Estate** ▪ Small-scale fencing/protective barriers around target species would protect select vegetation. ▪ Understory forest vegetation restoration would occur due to the rapid deer reduction described above. **Special-status Species** ▪ Same as alternative B.	**Fire Island Natural Areas** ▪ Same vegetation recovery as described under alternative C, with deer density reduced along the same timeline. **Sunken Forest** ▪ Same as alternative B. **William Floyd Estate** ▪ Deer would be excluded from this historic core, as described under alternative B. ▪ Rapid deer reduction would provide lower browsing pressure and recovery of understory forest vegetation, even in areas where deer exclusion fencing is not installed. **Special-status Species** ▪ Same as alternative B.

TABLE 9. SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONT'D)

Impact Topic	Alternative A (No-action)	Alternative B	Alternative C	Alternative D
Wetlands	Under alternative A, no actions would occur related to deer population management at the Seashore that would require encroachments and/or impacts on wetlands and their functions.	▪ Temporary disturbance to 273 linear feet of wetland vegetation during removal of vegetation needed for construction ▪ Temporary disturbance from sidecasted soil from post holes ▪ Temporary disturbance to wetland vegetation in later years during fence maintenance. ▪ Permanent displacement of vegetation where displaced by the fence. ▪ Wetland functions would remain intact.	Same as B	Same as B
White-tailed Deer Population	▪ Increased competition for resources could result in malnutrition resulting in weight loss, lower reproductive rates, and higher fawn mortality if deer numbers grow higher with no mechanisms for population control. ▪ The high population density also exerts a higher level of risk for the spread of communicable deer diseases such as chronic wasting disease. ▪ Deer would continue to be at risk of ingestion of harmful substances from foraging in garbage.	▪ The white-tailed deer population density would be reduced through use of an acceptable fertility control agent and would then be maintained at that density using the same method. The population would decline gradually over approximately 13 years as it reached the target density. ▪ Across the Seashore, fewer deer would be competing for resources, resulting in overall better population fitness. ▪ The population may experience unintended mortality of deer during handling needed for tagging deer treated with a fertility agent. ▪ The population may experience behavioral changes due to application of a fertility control agent. – Late season fawning possible by treated females. – Longer rutting period causing more energy exertion by adults, particularly bucks. ▪ In areas surrounding newly constructed deer exclosures, deer density would increase, resulting in increased competition for resources, until density is reduced through use of fertility control. ▪ The population may lose access to artificial food supplies with better refuse management and public information provided in the Fire Island communities and other lands adjacent to the Seashore.	▪ The white-tailed deer population density would be reduced through a variety of direct reduction methods, including sharpshooting, capture and euthanasia, and hunting, and would then be maintained at that density using the same methods. The population would decline rapidly over approximately two years as it reached the target density. ▪ As under alternative B, reduced deer numbers would result in improved habitat quality from lower browsing pressure and better deer population fitness. However, this fitness improvement would be realized more quickly that under alternative B. ▪ Deer exclosures would have the same localized increase in population density as described under alternative B; however, the density would be reduced much more rapidly. ▪ Same loss of artificial food supplies as under alternative B.	▪ The white-tailed deer population density would be reduced using the same methods described under alternative D, with the same impacts taking place along the same timeline; however, the Seashore would consider use of an acceptable fertility control agent in addition to or in place of the direct reduction methods for population density maintenance. ▪ Should the Seashore implement use of a fertility control agent, the related impacts described under alternative B would apply. ▪ Same loss of artificial food supplies as under alternative B.

TABLE 9. SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONT'D)

Impact Topic	Alternative A (No-action)	Alternative B	Alternative C	Alternative D
Other Wildlife and Wildlife Habitat	▪ Deer overbrowsing would continue to negatively impact food and shelter availability for other wildlife species. Forests species such as songbirds, insects, and small mammals would be particularly impacted by competition for remaining habitat. ▪ Residents of Fire Island communities may not understand the impacts of the plants they use for landscaping have. They may continue to propagate nonnative invasive species adjacent to natural areas, which could decrease habitat quality within the Seashore.	▪ Lower deer density would reduce deer browse of vegetation that provides food and shelter for other species. Forests species such as songbirds, insects, and small mammals would be particularly benefited by removal of competition for and by recovery of habitat. Deer density would be reduced gradually, reaching a density that would allow vegetation recover in approximately 13 years. ▪ Where exclosures are installed, wildlife would benefit from immediate removal of deer browsing; however, competition for resources and habitat alteration would continue at increased levels outside the exclosure until the deer density is effectively reduced. ▪ Wildlife would be disturbed during fencing installation, and fencing may disrupt natural movement patterns of some other wildlife species. ▪ A list of non-native invasive species to avoid along with a list of species encouraged to plant will be provided to the residents of Fire Island communities. This could help reduce the propagule pressure and spread of non-native invasive species to adjacent natural areas.	▪ Impacts would be the same as under alternative B with the following differences: – Deer density would be reduced more quickly, reaching a density anticipated to allow vegetation recovery over the course of approximately 2 years. – Less exclusion fencing would be installed, and where fencing is installed, the deer density outside it would be reduced rapidly (over approximately 2 years).	Same as alternative C.
Wilderness	**Fire Island Wilderness** ▪ Untrammeled, natural, and undeveloped qualities of wilderness diminished somewhat by existing management and monitoring activities; however, these actions would move the Fire Island Wilderness ecosystem towards desired conditions in the long term. ▪ Fire Island Wilderness would continue to offer opportunities for solitude and a primitive and unconfined type of recreation. ▪ The natural quality of the wilderness character could be diminished if deer density reaches a point where overgrazing causes an ecosystem imbalance.	**Fire Island Wilderness** ▪ Same impacts from ongoing resource management as described under alternative A. ▪ Untrammeled quality and opportunities for solitude would be diminished by use of fertility control (i.e., use of a chemical agent to alter deer biology). ▪ Opportunities for solitude could be further diminished by marking of translocated deer.	**Fire Island Wilderness** ▪ Same impacts from ongoing resource management as described under alternative A. ▪ Opportunities for solitude would be diminished for non-hunting visitors in the Fire Island Wilderness, but opportunities for solitude for hunters would be expanded by the establishment of deer hunting in Fire Island Wilderness.	**Fire Island Wilderness** ▪ Same impacts from ongoing resource management as described under alternative A. ▪ Impacts would be similar to both alternatives B and C because this alternative includes use a combination of population control methods: – Untrammeled quality and opportunities for solitude would be diminished by use of fertility control (i.e., use of a chemical agent to alter deer biology) – Opportunities for solitude would be diminished for non-hunting visitors in the Fire Island Wilderness, but opportunities for solitude for hunters would be expanded by the establishment of deer hunting in Fire Island Wilderness.
Cultural Landscapes (William Floyd Estate)	**Historic Core** ▪ Loss of character-defining features/landscape plantings would continue. ▪ The Seashore would remain unable to replant/maintain the gardens due to ongoing high levels of deer browsing. ▪ Small-scale fencing within the historic core would continue to impose a non-character defining feature within the cultural landscape. ▪ Lack of historically present vegetation inhibits visitor understanding of the cultural landscape. **Lower Acreage** ▪ The forest/field pattern may be altered over time due to the potential for forest regeneration to be inhibited by deer browse.	**Historic Core** ▪ Exclusion fencing within the historic core would add a non-character defining feature within the cultural landscape, altering views into and out of the historic core slightly; however, the fencing would be camouflaged within the tree line to minimize visual intrusion to the extent possible. ▪ Character-defining vegetation could be replanted (trees and garden) and would be able to flourish within the deer exclosure. This would also allow for enhanced visitor understanding of the cultural landscape. ▪ The west garden would be replanted and would flourish most as compared to the other alternatives. **Lower Acreage** ▪ Forested vegetation to recover and regenerate through use of two phases of rotational fencing. The forest/field patterns would be maintained.	**Historic Core** ▪ Small-scale fencing may allow the enhancement of select plantings within the historic core for visitor interpretation purposes, but the enhanced plantings would necessarily be limited in scope. Gardens outside of fencing would remain vulnerable to deer browse, albeit at lower levels than current conditions. ▪ Small-scale fencing within the historic core would continue to impose a non-character defining feature within the cultural landscape. **Lower Acreage** ▪ Once the deer population density decreases, the lower acreage forested vegetation could recover and regenerate. Over long-term, forest/field patterns maintained (a beneficial impact). This would allow recovery of regeneration more quickly than under alternative B.	**Historic Core** ▪ Same as alternative B. **Lower Acreage** ▪ Same as alternative C.

TABLE 9. SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONT'D)

Impact Topic	Alternative A (No-action)	Alternative B	Alternative C	Alternative D
Visitor Use and Experience/ Recreation	▪ Clear presence of deer in the Seashore. Deer viewing is frequent. Deer population could continue to grow, making viewing opportunities more frequent. This impact could be beneficial or adverse, depending on preference of the visitor. ▪ An increase in the deer population could reduce habitat and/or food sources for other wildlife species (other than deer). This would reduce the viewing potential for those other species. ▪ Deer are browsing vegetation at the William Floyd Estate, diminishing the cultural landscape and, therefore, the associated visitor experience of this resources. ▪ Continued trampling of vegetation could reduce the overall experience for visitors	▪ Enhanced education about deer management would make visitors aware of why the park is taking action and better educate them on how to avoid negative interactions. ▪ Deer population would be reduced gradually, reaching more sustainable densities in approximately 13 years through use of fertility control. – Reduced opportunities to view deer could be beneficial or adverse, depending on visitor preferences. – Could enhance viewing opportunities for other wildlife species. ▪ Visitors could be aware of the deer treatment activities occurring, which could reduce their overall experience. ▪ Visitors would no longer have the opportunity to view deer in the Sunken Forest, due to the exclusion of deer by fencing. ▪ Fencing could intrude on existing natural viewsheds, island-wide (including within the Sunken Forest) and at William Floyd Estate. ▪ Fencing could limit visitor access to some areas, especially during fence construction/installation; however, visitors would retain access to the Sunken Forest and the William Floyd Estate historic core. ▪ Visitors would benefit from an improved understanding of the cultural landscape at the William Floyd Estate due to restoration within fenced areas.	▪ Enhanced education about deer management would be the same as under alternative B. ▪ Deer population would be reduced more quickly than under alternative B, in approximately 2 years. Following reduction, impacts on visitor use and experience/recreation would be the same as under alternative B. ▪ Some visitors may be upset by the use of direct reduction methods; other visitors may appreciate the more efficient method of reduction. ▪ The Seashore would permit deer hunting in the wilderness, which would provide an additional recreational opportunity. ▪ Small fencing/protective barriers would remain installed within the William Floyd Estate. The fencing may detract from visitor experience but may allow some restoration of vegetation that would improve visitor understanding of the historic setting/cultural landscape at the William Floyd Estate. ▪ Same impacts of fencing of the Sunken Forest as described under alternative B.	▪ Enhanced education about deer management would be the same as under alternative B. ▪ This alternative combines impacts described under alternatives B and C. The same methods used to quickly reduce the population under alternative B would be used under this alternative. Fertility control methods may be used to maintain population levels following the initial reduction. As such, impacts would be the same as described under those alternatives. ▪ Same impacts from fencing of the William Floyd Estate and Sunken Forest, both described under alternative B.
Fire Island Communities and Adjacent Landowners	▪ Human-deer interactions would continue because of ongoing provision of artificial food sources, including presence of unsecured garbage. ▪ Deer would continue to use Fire Island communities for foraging habitat and for shelter. ▪ Deer would continue to browse on gardens and other plantings within the communities. ▪ Deer would continue to spill and/or feed from unsecured garbage cans.	▪ Negative interactions would be reduced through public education to reduce feeding of deer and properly secure garbage. ▪ Reduced deer browse (decreased gradually over approximately 13 years) would improve condition/appearance of community vegetation. ▪ Reduced deer viewing opportunities may improve or diminish community member experience, depending on individual sentiments toward particular species. ▪ Targeted removal of food-conditioned deer from the communities would reduce negative human-deer interactions	▪ Negative interactions would be reduced through public education, as under alternative B. ▪ Reduced deer browse would have the same impacts as described under alternative B; however, these impacts would be realized more quickly because the deer population would be decreased more rapidly (over approximately 2 years).	▪ Negative interactions would be reduced through public education, as under alternative B. ▪ Reduced deer browse would have the same impacts as described under alternative B, but along the same timeline as alternative C.
Public Health and Safety	▪ Deer may continue to approach humans because of ongoing food-conditioning of deer. ▪ Visitors would continue to be concerned over the perceived risk of tick-borne illness.	▪ Reduced chance of deer approaching humans because of educational outreach to reduce food-conditioning of deer. Fencing of the historic core of the William Floyd Estate would further reduce the perceived risk of tick-borne illness. ▪ Visitors concerned over the perceived risk of tick-borne illness would decrease due to educational outreach. ▪ Reduced negative human-deer interactions due to deer population density (decreased gradually over approximately 13 years).	▪ The same educational outreach as alternative B would reduce the risk of deer approaching humans. ▪ Reduced deer population density would have the same impacts as described under alternative B; however, these impacts would be realized more quickly because the deer population would be decreased more rapidly (over approximately 2 years)	▪ The same educational outreach as alternative B would reduce the risk of deer approaching humans. ▪ Reduced deer population density would have the same impacts as described under alternative B, but along the same timeline as alternative C.

TABLE 9. SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONT'D)

Impact Topic	Alternative A (No-action)	Alternative B	Alternative C	Alternative D
Seashore Operations	▪ Seashore staff would continue to spend approximately 270–300 hours annually on deer-related community outreach. Case Incident Reports would continue to require approximately 185 hours annually. ▪ Deer monitoring would continue annually on Fire Island in general, requiring approximately 120 hours for three staff. Additionally, monitoring would take place every 3 years within the Fire Island Wilderness and at the William Floyd Estate. Monitoring in the wilderness would require approximately 25 hours of time from two staff every 3-year cycle. Monitoring at the William Floyd Estate requires 25 hours from three staff every 3-year cycle. ▪ Staff time related to maintenance and repair of fencing would be limited, requiring approximately 4 hours per year at the William Floyd Estate and 32 hours (16 hours each for 2 staff) on Fire Island. The vegetation monitoring program would continue to be conducted every 5 years, requiring five dedicated staff for 4 months (460 hours).	▪ Same as alternative B, with an additional 180 hours for developing lesson plans for local schools and additional programs/interpretation. ▪ Time needed for Case Incident Reports may decrease due to a decreased deer population. ▪ A long-term increase in staff and budget would be required to implement application of an acceptable fertility control agent and maintenance of deer exclusion fencing. Costs are uncertain at this time and would be determined at a later date depending upon the agent that becomes available.	▪ Implementation of additional education programs and interpretation would require the same level of effort as alternative B. ▪ Use of sharpshooting and hunting would require a substantial increase in effort at the Seashore. ▪ The level of effort needed for maintenance of fencing would be less than required under alternative B.	▪ Implementation of additional education programs and interpretation would require the same level of effort as alternative B. ▪ Reducing the deer population using a combination of the methods described under alternatives B and C would require a substantial increase in effort at the Seashore. The costs to implement this alternative would be similar to those described under alternative C; however, the cost to use fertility control would be less than described under alternative B because its use would be limited to population maintenance (a less intensive use than when using it as the only method of population reduction). ▪ The level of effort associated with fencing would be greater than under alternative C but less than under alternative B.

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