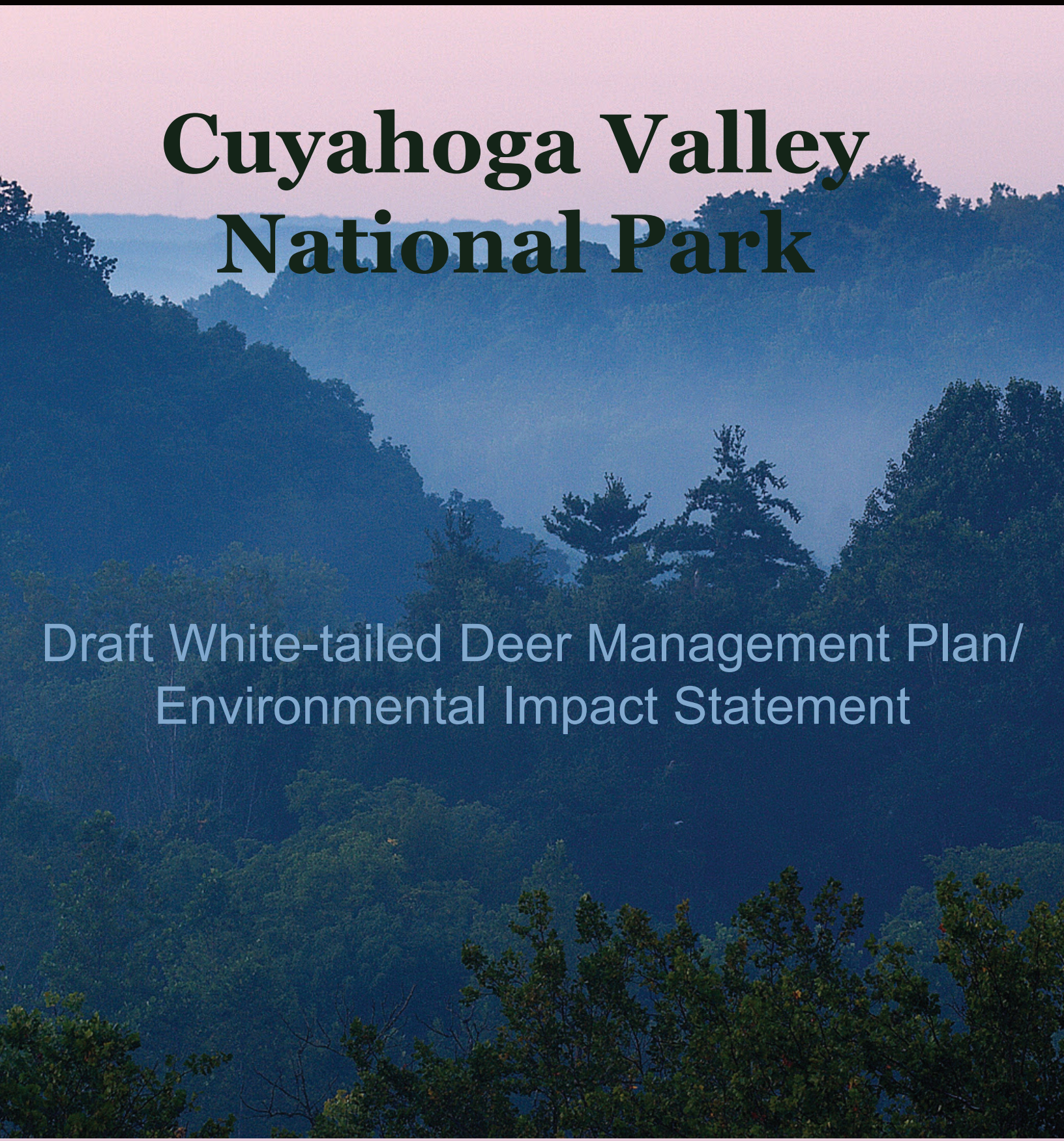
Cuyahoga Valley National Park
Draft White-tailed Deer Management Plan /
Environmental Impact Statement
Ohio

National Park Service
U.S. Department of the Interior



Cuyahoga Valley National Park

Draft White-tailed Deer Management Plan/ Environmental Impact Statement

2013

UNITED STATES DEPARTMENT OF THE INTERIOR – NATIONAL PARK SERVICE

DRAFT WHITE-TAILED DEER MANAGEMENT PLAN / ENVIRONMENTAL IMPACT STATEMENT CUYAHOGA VALLEY NATIONAL PARK, OHIO

Lead Agency: National Park Service (NPS), U.S. Department of the Interior

This Draft White-tailed Deer Management Plan/Environmental Impact Statement (plan/EIS) describes four alternatives for the management of deer at Cuyahoga Valley National Park, as well as the environment that would be affected by the alternatives and the environmental consequences of implementing these alternatives.

The purpose of this plan/EIS is to develop a white-tailed deer management plan that supports long-term protection, preservation, and restoration of native vegetation and other natural and cultural resources in Cuyahoga Valley National Park. Action is needed to provide the park with a long-term plan to address deer management because the population of the deer herd has grown and continues to exist at relatively high densities that can have adverse effects on the park's vegetation. Long-term ecological monitoring and exclosure studies at the park have found that deer browsing is severely impeding the growth of tree seedlings, limiting their height, and suppressing the growth of native groundcover. Deer browsing was also found to be related to a lower abundance of forest songbirds.

Under alternative A (no action), existing management would continue, including deer and vegetation monitoring, data management, and research. No new actions would occur to reduce the effects of deer overbrowsing. Alternative B would include all actions described under Alternative A and would incorporate a combination of nonlethal actions, including the construction of large-scale deer exclosures (fencing) for the purposes of forest regeneration. Nonsurgical reproductive control of does would be used to restrict population growth when this technology meets certain criteria. Alternative C would also include the actions described under Alternative A, and would add lethal deer management actions to reduce the herd size, including direct reduction of the deer herd by sharpshooting with firearms or by implementing capture and euthanasia of individual deer in certain circumstances where sharpshooting would not be appropriate. Alternative D includes all actions described under Alternative A, and it would also incorporate a combination of lethal and nonlethal actions from Alternatives B and C, namely the reduction of the deer herd through sharpshooting with firearms, capture and euthanasia in certain circumstances, and nonsurgical reproductive control of does with an acceptable reproductive control agent to maintain the population, when this technology meets certain criteria.

The potential environmental consequences of the alternatives are addressed for vegetation; white-tailed deer; other wildlife and wildlife habitat; special-status species; rural landscapes; socioeconomic resources/adjacent lands; visitor use and experience; visitor, employee, and volunteer health and safety; and park management and operations. Alternative D has been identified as the NPS preferred alternative and the environmentally preferable alternative.

The review period for this document will end 60 days after publication of the U.S. Environmental Protection Agency Notice of Availability in the Federal Register. During the 60-day comment period, comments will be accepted electronically through the NPS Planning, Environment and Public Comment website at http://parkplanning.nps.gov/cuva and in hard copy delivered by the U.S. Postal Service or other mail delivery service or hand-delivered to the address below. Oral statements and written comments will also be accepted during public meetings on the draft plan/EIS. Comments will not be accepted by fax, email, or in any other way than those specified above. Bulk comments in any format (hard copy or electronic) submitted on behalf of others will also not be accepted.

For further information, visit http://parkplanning.nps.gov/cuva or contact:

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U.S. Department of the Interior

Cuyahoga Valley National Park
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CUYAHOGA VALLEY NATIONAL PARK

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EXECUTIVE SUMMARY

PURPOSE OF AND NEED FOR ACTION

The purpose of this *White-tailed Deer Management Plan and Environmental Impact Statement* (plan/EIS) is to develop a white-tailed deer management plan that supports long-term protection, preservation, and restoration of native vegetation and other natural and cultural resources in Cuyahoga Valley National Park.

The white-tailed deer is a native species of Ohio and is a component of the natural ecosystems that are protected and maintained by the NPS. However, past and current changes in land use and habitat availability, as well as changes in predator populations and hunting activity, have affected the deer population in the Cuyahoga Valley and surrounding area. Cuyahoga Valley National Park began to address the issues associated with excessive deer numbers and overbrowsing impacts over 20 years ago, and since then has been conducting studies of both deer density and the effects of deer browsing on park resources. Deer density has varied and has decreased in many areas of the park in recent years, but there are large annual fluctuations and the densities remain above the levels that are considered desirable for forest regeneration. Long-term ecological monitoring and exclosure studies at the park have found that deer browsing is severely impeding the growth of seedlings, limiting the height of tree seedlings, and suppressing the growth of native groundcover. Deer browsing was also found to be related to a lower abundance of forest songbirds. Because the population of the deer herd has grown and continues to exist at relatively high densities that can have adverse effects on the park's vegetation, action is needed to provide the park with a long-term plan to address deer management and to ensure the following:

- Deer do not become the dominant force in the ecosystem adversely impacting forest regeneration, sensitive vegetation, and other wildlife.
- Natural distribution, abundance, and diversity of plant and animal species are not adversely affected by the large number of white-tailed deer in Cuyahoga Valley National Park.
- Declining forest regeneration is addressed and deer browsing does not continue at a level that eliminates or substantially reduces forest regeneration, and that unacceptable adverse changes to wildlife habitat and forest structure and composition do not occur.
- The park's cultural landscape preservation goals and mandates are not compromised by the large number of white-tailed deer in Cuyahoga Valley National Park.
- Deer management actions are coordinated with other jurisdictional entities and other stakeholders.

OBJECTIVES IN TAKING ACTION

Objectives define what must be achieved for an action to be considered a success. Alternatives selected for detailed analysis must meet the objectives to a large degree and must also resolve the purpose of and need for action. Using the park's enabling legislation, mandates and direction in other planning documents, servicewide objectives, NPS *Management Policies 2006*, and the NPS Organic Act (16 USC 1), park staff identified the following management objectives relative to deer management at Cuyahoga Valley National Park.

MANAGEMENT METHODOLOGY

- Develop and implement informed, scientifically defensible vegetation and wildlife impact levels and corresponding measures of deer population size that would serve as thresholds for taking adaptive management actions in the park.

WILDLIFE AND WILDLIFE HABITAT

- Reduce adverse effects of deer behavior, including browsing, trampling, and seed dispersal, on the natural abundance, distribution, and diversity of native wildlife species within the park.
- Protect habitat of wildlife species of concern, including rare, threatened, or endangered species, from adverse impacts related to deer behavior, including browsing, trampling, and seed dispersal.
- Maintain a viable white-tailed deer population within the park while protecting other park resources.

VEGETATION

- Reduce adverse effects of deer behavior, including browsing, trampling, and seed dispersal, on the natural abundance, distribution, and diversity of native plant species.
- Protect native plant species of concern, including rare, threatened, or endangered species, from adverse impacts related to deer behavior, including browsing, trampling, and seed dispersal.
- Reduce adverse effects of deer behavior, including browsing, trampling, and seed dispersal, on native plant species through dispersal, spread, and facilitation of exotic, invasive species.

CULTURAL RESOURCES

- Protect the integrity, variety, and character of the rural landscape by minimizing the effects of deer behavior on the rural landscape.

VISITOR EXPERIENCE

- Enhance public awareness and understanding of NPS resource management issues, policies, and mandates, especially as they pertain to deer management.
- Ensure that visitors have the opportunity to view deer in the natural environment at population levels that do not adversely impact visitors' enjoyment of other native species in the natural landscape.

WHITE-TAILED DEER MANAGEMENT AT CUYAHOGA VALLEY NATIONAL PARK

In national park system units in the eastern United States, such as Cuyahoga Valley National Park, landscapes have traditionally been managed to allow for the preservation and rehabilitation of scenic and historic landscapes. The result is a mixture of forest, fields, shrub, and grassland, which constitutes excellent habitat for white-tailed deer. Deer thrive on habitat conditions created by suburban development. New roads, housing, and related enterprises fragment forests and farms and create "edge" habitats that provide plenty of food and ample shelter for deer. Direct impacts from intense browsing include reductions in plant species richness (number of species), plant density and biomass, height

growth, and the development of vertical structure. Loss of plant species and vertical structure, leading to the decline of animal species that depend on these plants, represents the primary effect of browsing.

Cuyahoga Valley National Park has been taking steps toward addressing the issues related to high deer populations and overbrowsing since the early 1990s. In 1993 a deer management task force (DMTF) was established to identify the nature and extent of problems caused by deer and to recommend appropriate solutions. The task force included the park (at that time Cuyahoga Valley National Recreation Area), along with 11 representatives from six local municipalities and townships, both municipal park districts (Cleveland Metroparks and Metro Parks, Serving Summit County [MPSSC]), the Ohio Farm Bureau, and the Ohio Department of Natural Resources. The task force studied the issue of the deer population within a 178-square-mile area of concern that was centered on the park and included public and private lands. Its recommendations, which were first presented to Cuyahoga Valley Communities Council in 1996 (NPS 2002d), consisted of four methods of deer population control:

- Public sport hunting in areas where legal, practical, feasible, and safe.
- Specially controlled hunting on isolated land areas of greater than 5 acres.
- Sharpshooting in areas not suitable for public sport hunting or specially controlled hunting.
- Capture/euthanasia in developed areas where other methods are not practical or safe (NPS 1997a).

Following the task force recommendations, the NPS completed a *Final Environmental Assessment and Management Plan for White-tailed Deer*. On December 10, 1997, the U.S. District Court granted a preliminary injunction against the NPS to prohibit the proposed deer removal from taking place. Shortly thereafter, the NPS withdrew the plan and filed a motion to dismiss the case, which was accepted by the plaintiffs in the case, the Animal Protection Institute and other animal advocacy groups (*Animal Protection Institute v. Stanton*, Civil Action No. 97-2563; D.D.C. Dec. 10, 1997). However, deer management efforts, primarily sharpshooting activities, have been undertaken by neighboring agencies, including the Metroparks organizations and adjacent municipalities. Since that time, no deer management actions have been implemented by the park other than surveying and monitoring actions, and the need for a long-range plan still exists due to continued deer-related damage.

ALTERNATIVES CONSIDERED

The alternatives under consideration include a required “no action” alternative and three action alternatives that were developed by an interdisciplinary planning team and through feedback from the public and scientific community during the planning process. The three action alternatives would meet, to a large degree, the objectives for this plan and also the purpose of and need for action. The alternatives are described below.

Alternative A: No Action—Existing management would continue under Alternative A, including deer and vegetation monitoring, data management, and research. No new actions would occur to reduce the effects of deer overbrowsing.

Alternative B: Combined Nonlethal Actions—Alternative B would include all actions described under Alternative A, but it would incorporate a combination of nonlethal actions. These actions include the construction of large-scale deer exclosures (fencing) for the purposes of forest regeneration. In addition, nonsurgical reproductive control of does would be used to restrict population growth when this technology meets certain criteria.

Alternative C: Lethal Actions (Sharpshooting and Capture/Euthanasia)—Alternative C would include all actions described under Alternative A, but it would also add lethal deer management actions to reduce the herd size. The additional actions would include direct reduction of the deer herd by sharpshooting with firearms or by implementing capture and euthanasia of individual deer in certain circumstances where sharpshooting would not be appropriate.

Alternative D: Combined Lethal and Nonlethal Actions—Alternative D would also include all actions described under Alternative A, but it would incorporate a combination of lethal and nonlethal actions from Alternatives B and C. These actions would include the reduction of the deer herd through sharpshooting with firearms or capture and euthanasia and nonsurgical reproductive control of does with an acceptable reproductive control agent to maintain the population. Capture and euthanasia would be used in instances where sharpshooting would not be appropriate.

ENVIRONMENTAL CONSEQUENCES

The summary of environmental consequences considers the actions being proposed and the cumulative impacts to resources from occurrences inside and outside the park. The potential environmental consequences of the actions are addressed for vegetation; white-tailed deer; wildlife and wildlife habitat; special status species; rural landscapes; socioeconomics and adjacent lands; visitor use and experience; visitor, employee, and volunteer safety; and park management and operations.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: No Action	Alternative B: Combined Nonlethal Actions	Alternative C: Lethal Actions	Alternative D: Combined Lethal and Nonlethal Actions
Vegetation	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Moderate to major adverse impacts because browsing pressure would be expected to remain high in either all or a large portion of the park throughout the life of this plan.	Moderate to major adverse impacts because reproductive control would result in only a gradual reduction in the deer population, and the exclosures would protect only a small portion of the forest at any one time, requiring 10 years for regrowth above the browse line; short-term negligible impacts from deer management actions(e.g., bait pile placement, trampling).	Long-term and beneficial because the relatively rapid deer herd reduction would allow the abundance and diversity of vegetation throughout the park to recover and better protect special-status plants; short-term negligible impacts from deer management actions.	Same as Alternative C
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term, moderate, and adverse.	Long-term, moderate, and adverse.	Long-term beneficial.	Long-term beneficial.
White-tailed Deer	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Long-term, minor to moderate, adverse because browsing pressure would likely remain high in either all or a major portion of the park throughout the life of this plan; short-term negligible impacts from monitoring activities; also long-term moderate adverse impacts potentially from CWD (increased potential for spread with high deer density).	Long-term minor to moderate adverse impacts, mainly because reproductive control would result in a gradual reduction in the deer population and the exclosures would protect only a small portion of the forest at any one time, requiring 10 years for regrowth above the browse line; short-term negligible to minor impacts from deer management actions (bait piles, noise and disturbance); and long term-minor to moderate adverse impacts potentially from CWD (increased potential for spread with high deer density).	Long-term and beneficial because the relatively rapid deer herd reduction would allow the abundance and diversity of vegetation throughout the park to recover and better protect deer habitat; long-term minor adverse effects potentially from CWD (likelihood of spread) and short-term negligible adverse effects from implementing deer management actions (noise, disturbance).	Same as Alternative C.

Impact Topic	Alternative A: No Action	Alternative B: Combined Nonlethal Actions	Alternative C: Lethal Actions	Alternative D: Combined Lethal and Nonlethal Actions
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term, minor to moderate adverse.	Long-term, minor to moderate adverse.	Long-term beneficial.	Long-term beneficial.
Other Wildlife and Wildlife Habitat	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Long-term, and negligible to potentially major adverse, depending on the species. Species that depend on ground cover and young tree seedlings or understory shrubs for food or cover could be severely reduced or eliminated from the park, while impacts on species that depend primarily on other habitats (not woodlands) or on the upper canopy for food and cover would be negligible.	Same as Alternative A.	Mostly beneficial and long term; the long-term reduction and controls on deer population growth would allow vegetation used as food and cover for other wildlife to become more abundant, especially in zones that have deer densities far in excess of the desired level. There could be long-term minor adverse effects to some species and short-term negligible adverse impacts from disturbance during the implementation of the action.	Same as Alternative C.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term moderate adverse.	Same as Alternative A.	Long-term beneficial.	Long-term beneficial.
Special-status Species	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Adverse, long-term, and negligible to potentially major, depending on the species.	Same as Alternative A.	Mostly beneficial and long-term, depending on the species, with long-term minor adverse effects to some species that prefer open habitat and short-term negligible adverse impacts from disturbance during the implementation of the action.	Same as Alternative C.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Adverse, long-term, and minor to potentially major cumulative impacts, depending on the species.	Same as Alternative A.	Long-term beneficial.	Long-term beneficial.

Impact Topic	Alternative A: No Action	Alternative B: Combined Nonlethal Actions	Alternative C: Lethal Actions	Alternative D: Combined Lethal and Nonlethal Actions
Rural Landscapes	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Long-term, moderate, adverse due to the continued high levels of the deer population and the associated ongoing depredation of plantings and crops by deer in unfenced rural landscape areas.	Long-term, moderate adverse because, in the majority of the park not fenced, agricultural crops and other vegetation would continue to be adversely affected by deer browsing until reproductive controls became effective and the population decreased; in addition, the presence of exclosures would result in long-term minor adverse impacts to the cultural landscapes in which they are located.	Short-term negligible adverse but mostly long-term beneficial impacts due to decreased browsing and thus decreased deer depredations of agricultural crops, which would lead to increased chances of viability for the park's farm ventures and maintain the open and closed patterns of the rural landscape.	Same as Alternative C.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term minor to moderate adverse.	Long-term moderate adverse.	Long-term beneficial.	Long-term beneficial.
Socioeconomic Resources/Adjacent Lands	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Long-term, minor to moderate, adverse because of the continued high density of deer expected over the life of this plan and the associated costs of landscape damage, crop loss, and additional costs for fencing, repellents, and other forms of deer control to protect landscaping, as well as protection of livestock from disease.	Long-term moderate adverse impacts for the same reasons as Alternative A, but with the additional impact of precluding deer from the large exclosures, which could add to browsing pressure on surrounding lands.	Long-term and beneficial because the relatively rapid reduction in deer density would reduce adverse impacts to landowners, due to improved crop yields and preserved landscaping and reduce the need for landscape, crop and livestock protection.	Same as Alternative C.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term minor to moderate adverse.	Long-term moderate adverse.	Long-term beneficial.	Long-term beneficial.

Impact Topic	Alternative A: No Action	Alternative B: Combined Nonlethal Actions	Alternative C: Lethal Actions	Alternative D: Combined Lethal and Nonlethal Actions
Visitor Use and Experience	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Both beneficial and adverse to those visitors who maybe primarily interested in viewing deer (beneficial in that there would be more deer to see, adverse in that the appearance of the herd could be poor). However, overall impacts related to a decreased ability to view scenery (including native vegetation and the rural landscape) and other wildlife, which is important to many visitors using the park, would be long term, minor to moderate, adverse.	Both beneficial and adverse to those visitors, similar to Alternative A, since deer would still be present in relatively high numbers for a long time. Adverse impacts to visitor use and experience from the presence of exclosures and the continued effects of deer overbrowsing would range from negligible to moderate, and impacts related to forest regeneration would gradually become beneficial in the long term, beyond the life of this plan. Visitors may see various aspects of the reproductive control operations, which could result in minor adverse impacts to their visitor experience.	Would vary between users; impacts would be short and long-term, moderate to major adverse to those opposed to lethal deer management within the park and minor adverse effects during implementation from disturbance, but long-term and beneficial to those who value an increase in vegetative and wildlife diversity and being able to view natural and rural landscapes unaffected by overbrowsing.	Same as Alternative C.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term negligible adverse.	Long-term beneficial.	Long-term negligible adverse.	Long-term negligible adverse.
Visitor, Employee, and Volunteer Health and Safety	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Long-term, adverse and range from negligible to potentially major depending on the source and outcome of accident.	Same as Alternative A.	Long-term, negligible to minor adverse with long-term beneficial impacts in several areas of risk due to the reduction in deer density.	Same as Alternative C.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term, moderate, adverse.	Same as Alternative A.	Long-term negligible adverse.	Same as Alternative C.

Impact Topic	Alternative A: No Action	Alternative B: Combined Nonlethal Actions	Alternative C: Lethal Actions	Alternative D: Combined Lethal and Nonlethal Actions
Park Management and Operations	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Long-term, negligible to minor adverse; because present deer management actions would continue, the park's deer population is expected to continue to fluctuate and remain at high levels, resulting in long-term demands on park staff and funding for managing the deer herd and protecting other park resources.	Long-term, moderate to potentially major adverse impacts on park management and operations from installing and maintaining large exclosures, and implementing and monitoring reproductive controls, with minor adverse impacts from increased educational/interpretive activities and CWD surveillance.	Moderate adverse impacts during the period of direct reduction efforts because of the need for additional staff time for monitoring and coordinating activities. The use of qualified federal employees or authorized agents would reduce the amount of park staff time needed for implementation, but would still result in costs. With the greater reduction of deer over a shorter period of time, park staff would have more time to apply their efforts to other areas of the park when compared to Alternative A, which would reduce adverse, long-term impacts from moderate to minor over time, with long-term minor adverse impacts from increased educational/interpretive activities and CWD surveillance.	Moderate adverse impacts, as park staff involvement would be required for coordination and monitoring of the reduction and reproductive control actions. Once the deer herd was reduced, more staff time would be available for other activities, resulting in long-term, minor adverse impacts, with long-term minor adverse impacts from increased educational/interpretive activities and CWD surveillance.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term minor adverse.	Long-term moderate to major adverse.	Long-term moderate adverse.	Long-term moderate adverse.

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Acronyms and Abbreviations

ACHP	Advisory Council on Historic Preservation
ATF	Bureau of Alcohol, Tobacco, Firearms, and Explosives
AVMA	American Veterinary Medical Association
BRMD	Biological Resource Management Division
BSE	bovine spongiform encephalopht
Btk	Bacillus thuringiensis var. kurstaki
CDC	Centers for Disease Control and Prevention
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CJD	Creutzfeldt-Jakob disease
CWD	chronic wasting disease
DMTF	Deer Management Task Force
EHD	epizootic hemorrhagic disease
EIS	environmental impact statement
EPMT	exotic plant management team
EPA	U.S. Environmental Protection Agency
EQD	Environmental Quality Division (National Park Service)
ESA	Endangered Species Act
FMP	fire management plan
GMP	general management plan
GnRH	gonadotropin releasing hormone
HD	hemorrhagic disease
HSUS	Humane Society of the United States
MOU	memorandum of understanding
MPSSC	Metro Parks, Serving Summit County
NEPA	National Environmental Policy Act
NHP	National Historical Park
NHPA	National Historic Preservation Act
NOI	notice of intent
NPS	National Park Service
NRHP	National Register of Historic Places
ODA	Ohio Department of Agriculture
ODNR	Ohio Department of Natural Resources
ODPS	Ohio Department of Public Safety
PEPC	Planning, Environment, and Public Comment
PL	Public Law
plan/EIS	White-tailed Deer Management Plan and Environmental Impact Statement
PZP	porcine zona pellucida

ROD	record of decision
SHPO	state historic preservation officer
TSE	transmissible spongiform encephalopathies
USC	United States Code
USDA	U.S. Department of Agriculture
USDA-APHIS	USDA Animal and Plant Health Inspection Service
USDA-ARS	USDA Agricultural Research Service
USDA-WS	USDA APHIS Wildlife Services
USFS	USDA Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WRHS	Western Reserve Historical Society

Chapter 1

Purpose of and Need for Action

CHAPTER 1: PURPOSE OF AND NEED FOR ACTION

1.1 INTRODUCTION

This chapter explains what this plan intends to accomplish and explains why the National Park Service (NPS) is taking action at this time. This *White-tailed Deer Management Plan and Environmental Impact Statement* (plan/EIS) presents three action alternatives for managing white-tailed deer (*Odocoileus virginianus*) at Cuyahoga Valley National Park (the park), and assesses the impacts that could result from continuation of the current management framework (Alternative A: No-Action Alternative) or implementation of any of the three action alternatives. Upon conclusion of the plan and the decision-making process, the alternative that is selected will become the white-tailed deer management plan for the park, which will guide future actions for a period of 15 years. Brief summaries of both purpose and need are presented here, but more information is available in "Section 1.4, Scientific Background: Deer and Ecosystem Management."

The plan/EIS complies with the National Environmental Policy Act of 1969 (NEPA) and its implementing regulations (40 CFR 1500–1508). The plan/EIS also complies with Section 7 of the Endangered Species Act [16 U.S. Code (USC) 1536(a)(2)], and Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended. It presents deer management methods and strategies for the park, as well as the analysis of existing resource conditions and impacts that may occur on these resources as a result of the proposed management options. The plan has been developed in cooperation with local, state, and regional entities, as well as other federal agencies. A science team (see "Chapter 5: Consultation and Coordination") assisted with the planning process by evaluating scientific literature and research on the topic of deer management, reviewing and recommending monitoring protocols for park deer populations and other park resources, and identifying appropriate action thresholds at which deer management strategies would be implemented. Monitoring protocols and action thresholds were incorporated into all action alternatives evaluated during plan development. Established thresholds reflect the identified plan objectives to maintain the deer population as one component of a diverse, healthy ecosystem and to prevent unacceptable impacts to other park resources or values. Deer management strategies are adaptive and dynamic, allowing for the incorporation of new scientific information over time that may modify management methods to best meet objectives in taking action.

1.2 PURPOSE OF AND NEED FOR ACTION

An understanding of the purpose of and need for action was developed from analysis of the results of the Cuyahoga Valley National Park general management planning process and of data gathered to date.

1.2.1 PURPOSE OF THE PLAN / ENVIRONMENTAL IMPACT STATEMENT

The purpose of this plan/EIS is to develop a white-tailed deer management plan that supports long-term protection, preservation, and restoration of native vegetation and other natural and cultural resources in Cuyahoga Valley National Park.

The purpose of this plan/EIS is to develop a white-tailed deer management plan that supports long-term protection, preservation, and restoration of native vegetation and other natural and cultural resources in the Park.

1.2.2 NEED FOR ACTION

The white-tailed deer is a native species of Ohio and is a component of the natural ecosystems that are protected and maintained by the NPS. Past and current changes in land use and habitat availability, as well as changes in predator populations and hunting activity, have affected the deer population in the Cuyahoga Valley and surrounding area. After being nearly extirpated in the late 1800s and early 1900s, the Ohio deer population began to recover due to emigration, transplant activities, changes in land use, and herd management, as well as decreased mortality due to declines in natural predation (McCabe and McCabe 1984). This recovery is reflected in dramatically increasing deer numbers in the state since the mid- to late 1900s. In Ohio, the number of deer was estimated at near zero in 1940 (Iverson and Iverson 1999) and 85,000 in 1975 (Ohio Department of Natural Resources [ODNR] 2005a). In 1995 the white-tailed deer in Ohio numbered over 450,000 (Iverson and Iverson 1999). In 2009, the ODNR Division of Wildlife estimated that Ohio's deer herd numbered approximately 650,000 (ODNR 2009a). The statewide deer population was estimated to be 750,000 in October 2011 (Egan 2011). Studies show that excessive deer browsing reduces forest regeneration, resulting in adverse changes to forest structure and composition and to wildlife habitat.

Cuyahoga Valley National Park began to address the issues associated with excessive deer numbers and overbrowsing impacts over 20 years ago, and since then has been conducting studies of both deer density and the effects of deer browsing on park resources. Deer density has varied and has decreased in many areas of the park in recent years, but there are large annual fluctuations and the densities remain above the levels that are considered desirable for forest regeneration. Long-term ecological monitoring and exclosure studies at the park have found that deer browsing is severely impeding the growth of seedlings, limiting the height of tree seedlings, and suppressing the growth of native groundcover. Deer browsing was also found to be related to a lower abundance of forest songbirds. References and additional information regarding the effects of deer overabundance on vegetation structure and species diversity can be found in "Section 1.4, Scientific Background: Deer and Ecosystem Management," "Section 3.2, Vegetation" and "Section 3.4, Other Wildlife and Wildlife Habitat."

Because the population of the deer herd has grown and continues to exist at relatively high densities that can have adverse effects on the park's vegetation, action is needed to provide the park with a long-term plan to address deer management and to ensure the following:

- Deer do not become the dominant force in the ecosystem adversely impacting forest regeneration, sensitive vegetation, and other wildlife.
- Natural distribution, abundance, and diversity of plant and animal species are not adversely affected by the large number of white-tailed deer in Cuyahoga Valley National Park.
- Declining forest regeneration is addressed and deer browsing does not continue at a level that eliminates or substantially reduces forest regeneration, and that unacceptable adverse changes to wildlife habitat and forest structure and composition do not occur.
- The park's cultural landscape preservation goals and mandates are not compromised by the large number of white-tailed deer in Cuyahoga Valley National Park.
- Deer management actions are coordinated with other jurisdictional entities and other stakeholders.

1.2.3 OBJECTIVES IN TAKING ACTION

Objectives define what must be achieved for an action to be considered a success. Alternatives selected for detailed analysis must meet the objectives to a large degree and must also resolve the purpose of and need for action. Using the park's enabling legislation, mandates and direction in other planning documents, servicewide objectives, NPS *Management Policies 2006* (NPS 2006a), and the NPS Organic Act (16 USC 1), park staff identified the following management objectives relative to deer management at Cuyahoga Valley National Park.

Management Methodology

- Develop and implement informed, scientifically defensible vegetation and wildlife impact levels and corresponding measures of deer population size that would serve as thresholds for taking adaptive management actions in the park.

Wildlife and Wildlife Habitat

- Reduce adverse effects of deer behavior, including browsing, trampling, and seed dispersal, on the natural abundance, distribution, and diversity of native wildlife species within the park.
- Protect habitat of wildlife species of concern, including rare, threatened, or endangered species, from adverse impacts related to deer behavior, including browsing, trampling, and seed dispersal.
- Maintain a viable white-tailed deer population within the park while protecting other park resources.

Vegetation

- Reduce adverse effects of deer behavior, including browsing, trampling, and seed dispersal, on the natural abundance, distribution, and diversity of native plant species.
- Protect native plant species of concern, including rare, threatened, or endangered species, from adverse impacts related to deer behavior, including browsing, trampling, and seed dispersal.
- Reduce adverse effects of deer behavior, including browsing, trampling, and seed dispersal, on native plant species through dispersal, spread, and facilitation of exotic, invasive species.

Cultural Resources

- Protect the integrity, variety, and character of the rural landscape by minimizing the effects of deer behavior on the rural landscape.

Visitor Experience

- Enhance public awareness and understanding of NPS resource management issues, policies, and mandates, especially as they pertain to deer management.
- Ensure that visitors have the opportunity to view deer in the natural environment at population levels that do not adversely impact visitors' enjoyment of other native species in the natural landscape.

1.2.4 DESIRED CONDITIONS

This plan/EIS addresses desired conditions for the Park, the desired condition of the deer population, and the desired condition of the forest.

This section defines the desired conditions for the park, which are connected to the purpose, need, and objectives of this plan/EIS. Two objectives were factored into the definition of desired conditions:

- **Sustainable forest**—Several objectives of this plan address the need to reduce adverse effects of deer behavior, including browsing, trampling, and seed dispersal, on native vegetation, which supports the overall desire for a sustainable forest. The science team suggested that, for the purposes of this plan, a sustainable forest is defined as a mature eastern deciduous forest with adequate native regeneration and understory growth and minimal invasive species growth.
- **Viable deer population**—Deer are a natural part of the ecosystem and play an important role in it. One of the objectives of this plan is to maintain a viable white-tailed deer population in the park, while protecting other park resources. For the purposes of this plan, a viable population is defined as one that is balanced; that is, it has representation of all age classes and a sex ratio that ensures long-term viability.

1.2.5 AUTHORITY TO MANAGE DEER

In accordance with the NPS Organic Act (16 USC 1), the NPS has broad authority to manage wildlife and other natural resources within the boundaries of units of the national park system. According to 16 USC 1, the NPS "shall promote and regulate the use of Federal areas known as national parks … by such means and measures as conform with the fundamental purpose of the parks … to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations."

In defining this discretion, the 10th Circuit Court of Appeals overturned a district court decision in *New Mexico State Game Commission v. Udall* (410 F. 2d 1197, 1201), holding in part that the NPS "need not wait until the damage through overbrowsing has taken its toll on park plant life … before taking preventative action" (10th Cir. 1969). This discretion has been reinforced over time. In *United States v. Moore* (640 F. Supp. 164, 166), the court found that Congress had given the Secretary of the Interior great discretion in regulating and controlling wildlife in the national park system (S.D.W.Va. 1986). This discretion is further defined by NPS *Management Policies 2006* (NPS 2006a).

NPS *Management Policies 2006*, Section 4.4.2, states, "[w]henever possible, natural processes will be relied upon to maintain native plant and animal species and influence natural fluctuations in populations of these species. The Service may intervene to manage populations or individuals of native species only when such intervention will not cause unacceptable impacts to the populations of the species or to other components and processes of the ecosystems that support them." In addition, the policy restricts management to times when certain conditions exist. One such condition is when "a population occurs in an unnaturally high or low concentration as a result of human influences (such as loss of seasonal habitat, the extirpation of predators, the creation of highly productive habitat through agriculture or urban landscapes) and it is not possible to mitigate the effects of the human influences" (NPS 2006a).

However, as part of any animal population management action, the NPS is required to follow an established planning process, including provisions for public review and comment. NPS *Management Policies 2006* also requires that parks "assess the results of managing plant and animal populations by

conducting follow-up monitoring or other studies to determine the impacts of the management methods on nontargeted and targeted components of the ecosystem" (NPS 2006a, Section 4.4.2). This plan/EIS describes this strategy, including specific thresholds for taking action and endpoints on management actions.

1.3 DESCRIPTION OF CUYAHOGA VALLEY NATIONAL PARK

1.3.1 PROJECT SITE LOCATION

The study area for this plan/EIS is Cuyahoga Valley National Park in its entirety (see Figure 1-1). The park is located in northeastern Ohio, situated between the two major metropolitan areas of Cleveland and Akron. The park spans portions of two counties: southeastern Cuyahoga County and northwestern Summit County. The park preserves approximately 33,000 acres along 22 miles of the Cuyahoga River (NPS 2009a). The NPS owns approximately 19,800 acres within the legislative boundary of the park. Most of the remaining area (approximately 8,200 acres) is owned and managed by other public entities such as Cleveland Metroparks and Metro Parks, Serving Summit County (MPSSC). Nearly 4,900 acres remain in private use for recreational (golf courses, ski slopes, a historic village, performing arts facilities, and scout camps), scattered residential, agricultural, or industrial uses (NPS 2011a). Park boundaries overlap and adjoin those of numerous political subdivisions. A network of over 100 miles of roads crosses the park, ranging from secondary township roads to more heavily traveled county roads, state routes, and three interstate highways. In addition, a historic railroad and remnants of the Ohio & Erie Canal run the entire length of the valley.

1.3.2 HISTORY OF CUYAHOGA VALLEY NATIONAL PARK

The Cuyahoga Valley has been occupied by humans for over 12,000 years and was originally a key transportation route for Native Americans. In 1786 the first Europeans arrived in the valley and established a short-lived missionary settlement known as "Pilgerruh" within what would soon become the Western Reserve of Connecticut (NPS n.d.a). European settlers found great hunting opportunities and ideal locations for trading posts. The Ohio and Erie Canal was completed from Cleveland to Portsmouth, Ohio in 1832 (NPS 1984). This 308-mile-long canal allowed goods to travel from Ohio down the Mississippi to the Gulf of Mexico and from Cleveland on Lake Erie to Buffalo and from there to the east coast. The canal laid the foundation for Ohio's industrial, commercial, and political development. The growing prosperity in Ohio led to the development of small towns and cities along the waterway. In 1880, the Valley Railway was constructed to support Cleveland's growing steel industry (NPS n.d.a). The railway was built next to, and sometimes on top of, the Ohio and Erie Canal, and provided a faster transport for the coal and other goods needed to fuel the new industrial economy (NPS n.d.a; Platt 2006). Beginning in the 1870s city dwellers were picnicking, boating, hiking, and studying nature in the countryside, taking advantage of the recreational opportunities in the Cuyahoga Valley (NPS 1992a).

Actual park development began in the 1910s and 1920s with the establishment of Cleveland and Akron metropolitan park districts (NPS n.d.b). The Ohio General Assembly passed the County Park Commission Act of 1911, which established a level of parks between the city and state to serve metropolitan Cleveland in Cuyahoga County. In 1917 the Cleveland Metropolitan Park District was formed to supervise metropolitan park operations (Cockrell 1992). In 1925, the famous Olmsted Brothers landscape architecture firm prepared a study for Akron and Summit County parks that highlighted the recreational potential of the Cuyahoga Valley.

In 1929, the estate of Cleveland businessman Hayward Kendall donated 430 acres around the Ritchie Ledges and a trust fund to the state of Ohio. Kendall's will stipulated that the property be used for park

purposes, and the land subsequently became Virginia Kendall Park, in honor of Kendall's mother. In the 1930s, the Civilian Conservation Corps built much of the park's infrastructure, including what is now Happy Days Lodge and the shelters at Octagon, Ledges, and Kendall Lake (NPS n.d.b). In addition, the Boy Scouts and Girl Scouts of America established summer camps in the valley during the 1930s, and Camp Mueller opened in 1941 as an Akron city youth camp.

Following World War II, private recreational interests, such as the 167-acre Brandywine Country Club and Golf Course, became established in the valley. The Brandywine Ski Area (215 acres) and the Boston Mills Ski Area (88 acres) were also developed. Quasi-public facilities like Jonathan Hale Farm and Western Reserve Village, Blossom Music Center, and the Kent State University Porthouse Theatre also found homes in the valley (Scrattish 1985). In 1956 Hale Farm (176 acres) was bequeathed to the Western Reserve Historical Society (WRHS) "to perpetuate the history and culture of the Western Reserve"; the farm depicts lifestyles before 1850. A replica Western Reserve Village was established directly across the road from the Hale homestead as a center for pioneer craft demonstrations (Scrattish 1985).

From the 1950s through the early 1970s, development continued to expand in the Cuyahoga Valley. Rapidly developing industries in the area became a source of pollution. In 1969 the Cuyahoga River caught on fire due to dumping of flammable materials from nearby refineries in Cleveland, and the river was deemed a "dead river" (U.S. Environmental Protection Agency [EPA] 2008). However, this was not the first or only time the river had caught fire. Prior to 1969, the Cuyahoga River burned in 1868, 1883, 1887, 1912, 1922, 1936, 1941, 1948, and 1952. The 1952 fire caused nearly $1.5 million in damage. In fact, the fire in 1969 was modest in scale and initially attracted little attention. Fame came later when *Time* magazine ran an article about the incident in its August 1 issue. The event helped spur an avalanche of pollution control activities, resulting in the Water Quality Improvement Act of 1970, the Clean Water Act of 1972, the Great Lakes Water Quality Agreement, and creation of the state and federal environmental protection agencies (NPS n.d.g).

By the 1970s many people began to consider proposing a park to create a buffer against commercial development in the valley (Scrattish 1985) and to save the valley's green space and historical features. Local leaders worked to establish the Cuyahoga Valley as a national park system unit. However, an investigation in 1966 by the Bureau of Outdoor Recreation and the NPS evaluated the valley against the criteria for national recreation areas and concluded that the area did not meet two of the primary criteria for a national recreation area: (1) the severely polluted river prohibited the development of any water-related recreational facilities and (2) the valley did not possess outstanding natural values that would draw visitors from beyond northeast Ohio.

A second bill to create a federal park caused much debate. However, despite the controversy, there was support for a federal park unit, and on December 27, 1974, President Gerald Ford approved Public Law (PL) 93-555 creating Cuyahoga Valley National Recreation Area for the purpose of preserving and protecting the Cuyahoga River and the adjacent lands (Cockrell 1992). Cuyahoga Valley National Recreation Area was renamed a national park in 2000, making it more recognizable as a unit of the national park system (NPS n.d.b).

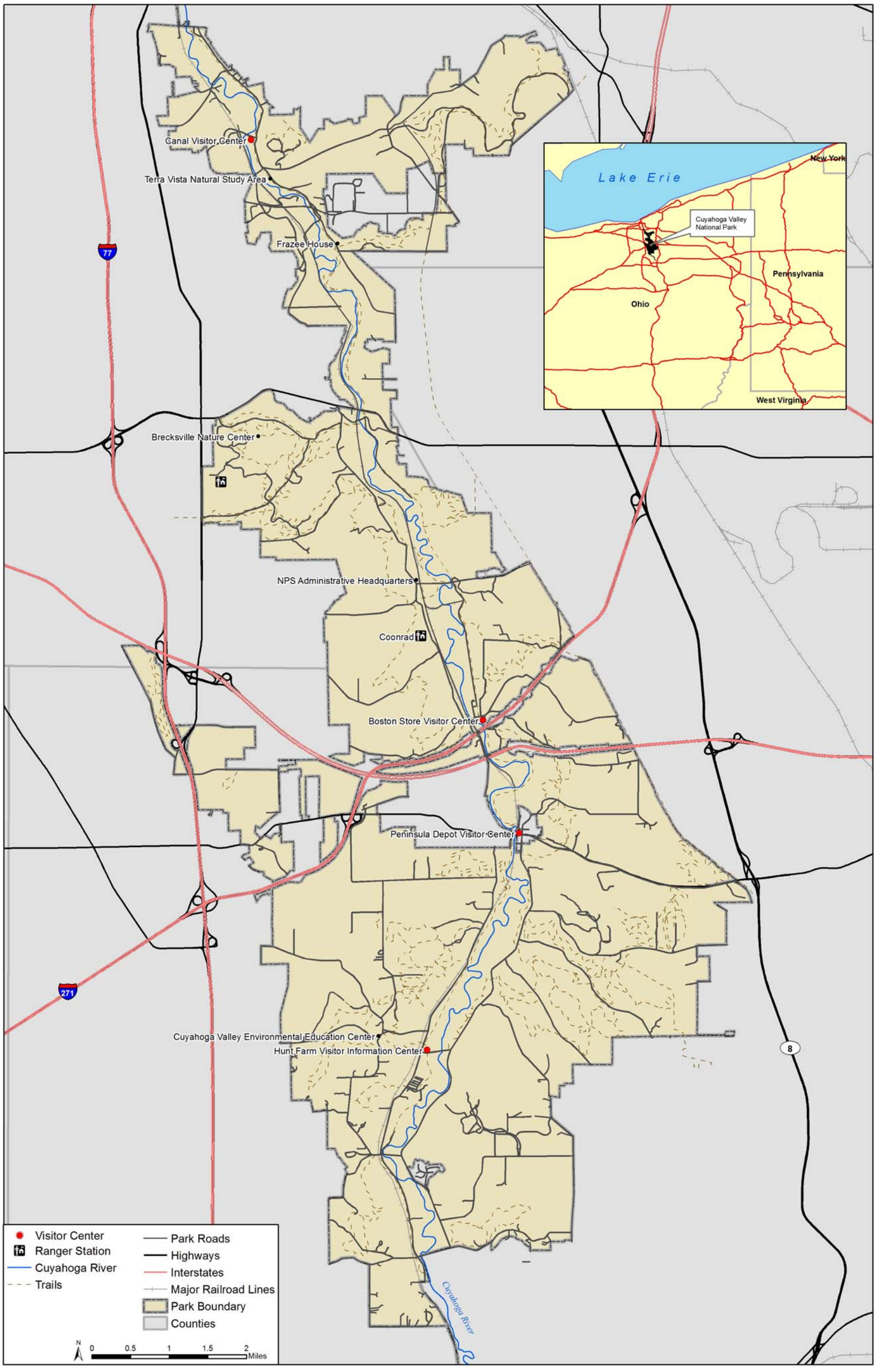
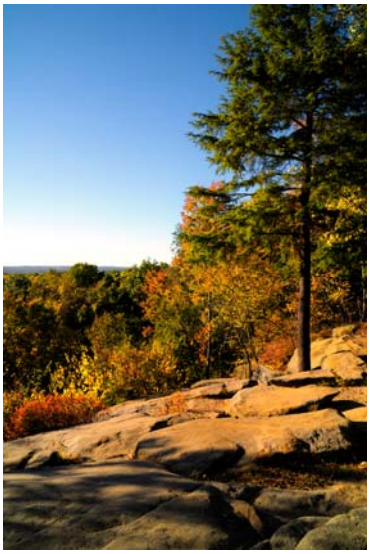


FIGURE 1-1: CUYAHOGA VALLEY NATIONAL PARK LOCATION

1.3.3 OVERVIEW OF PARK RESOURCES



Cuyahoga Valley National Park

The Cuyahoga River, which is fed by more than 190 miles of perennial (permanent) and ephemeral (temporary) streams, winds through the Cuyahoga Valley and forms the backbone of the park (NPS 2009a, 2011b). The unique physical character of the valley was formed by the mingling of two diverse geographic regions: the Appalachian Plateau and the Central Lowlands. Modified by glaciers, the valley is rugged and steep-sided and backed by high, narrow hills. Closely spaced ravines funnel tributaries to the river; some streams descend up to 600 feet in a distance of only a few miles. The park not only offers a rich natural diversity that results from the valley's unique geography and geologic history, but it also has some of the largest remaining tracts of forest in northeast Ohio (NPS 2009a).

The park includes a diverse mosaic of natural vegetation types alongside various human-developed land uses. The park's natural vegetation is composed primarily of deciduous forest, with oak/hickory associations being the most widespread. Others include oak/beech/maple, maple/sycamore, and hemlock/beech associations. Several large neighboring tracts of forest remain, but most forested areas are heavily fragmented. Interspersed among these forests are other natural habitats, including older field habitats in various stages of succession, wet meadows, and other wetland habitats (NPS 2009a). Inventories of the park's vegetation have documented over 1,100 species of plants. The park's diverse habitats support 39 confirmed state-listed rare plant species, including sedges, grasses, wildflowers, and shrubs (NPS 2011g). Wildlife studies throughout the park have identified 247 species of birds, 36 mammals, 18 amphibians, 20 reptiles, 62 butterflies, and 64 fish (Plona, pers. comm., 2011).

Goats grazing in pasture

The park also contains numerous cultural resources, which are "the material evidence of past human activities. Finite and non-renewable, these tangible resources begin to deteriorate almost from the moment of their creation. Once gone, they cannot be recovered" (NPS 2003). Cultural resources include archeological resources, structures, buildings, cultural landscapes, museum objects, and ethnographic resources. At Cuyahoga Valley National Park, the rural landscape, a type of cultural landscape, is the primary cultural resource of interest for this plan (see "Section 1.8, Issues and Impact Topics," for more information).

1.3.4 PARK PURPOSE, SIGNIFICANCE, AND MISSION

The U.S. Congress sets aside as national parks places that represent outstanding aspects of our natural and cultural heritage to ensure they receive the highest standards of protection. A statement of park purpose captures the reasons for which a park was set aside as part of the national park system. It provides the fundamental criterion against which the appropriateness of all plan recommendations and future operational decisions and actions are tested:

> Therefore, the purpose of Cuyahoga Valley [National Park] is to preserve the resources contained within the boundaries of the park, to make those resources available for public use, and to encourage preservation and educational activities throughout the entire area of the National Heritage Corridor (NPS 2000b).

The park's significance statement is based on the establishing legislation as well as on subsequent scholarship about a place or theme. It identifies the resources and values central to managing the park and expresses the importance of the park to our national heritage. Understanding what is nationally significant about a park helps managers make decisions that preserve the resources and values that were the basis for establishment of the park. Such decisions include setting resource management priorities and identifying interpretive themes and appropriate visitor experiences. A statement of significance focuses efforts and funding on the resources and experiences that matter most:

> The park preserves and interprets a major portion of the Cuyahoga River Valley, which includes a rich diversity of cultural and natural resources. The park, the largest of its kind in the Midwest, includes the nationally significant Ohio & Erie Canal; numerous prehistoric sites; 64 National Register listings including historic districts, historic structures, Civilian Conservation Corps sites, examples of settlement patterns reflecting the area's Western Reserve of Connecticut heritage, and the Valley Railroad; a thriving riparian ecosystem; scenic landforms that portray the area's Pleistocene glacial activity; one of the National Park Service's premier environmental education programs; and a wide variety of recreational opportunities provided by the National Park Service and numerous partners such as Hale Farm and Village, Cleveland Metroparks, Metro Parks, Serving Summit County, Blossom Music Center, two ski areas, and youth camps. The park also lies within the Ohio & Erie Canal National Heritage Corridor and fulfills a crucial role in assisting the Ohio & Erie Canal Association develop the 110-mile-long corridor (NPS 2000b).

A park's mission is a vision for the future and articulates, in broad terms, the ideas that the NPS strives to achieve:

> At Cuyahoga Valley [National Park], the National Park Service mission is to manage the [Park] through creative leadership and development of partnerships that will enable full realization of the Park's and Ohio & Erie Canal National Heritage Corridor's scenic, natural, historic, recreational, and educational values for the benefit of the community, the visiting public, and future generations (NPS 2000b).

1.4 SCIENTIFIC BACKGROUND: DEER AND ECOSYSTEM MANAGEMENT

1.4.1 DEER MANAGEMENT ISSUES AND RESEARCH OVERVIEW

Park staff has worked with technical experts and researchers to develop and implement methods and protocols for monitoring white-tailed deer population size and the impacts of browsing on forest plant communities. This research, in cooperation with local, state, federal, and regional entities, has informed the development of this plan/EIS. A science team, consisting of scientists and other specialists from a variety of state and federal government organizations, has helped define components of the planning process (team participants are listed in "Chapter 5: Consultation and Coordination"). The team evaluated scientific literature and research on the topic of deer management, recommended a monitoring protocol for park deer populations and other park resources, and recommended a basis for the resource thresholds

at which deer management strategies would be implemented. Monitoring protocols and impact thresholds are a component of all action alternatives evaluated in the analysis, helping ensure that the deer population at the park becomes a balanced component of a functioning ecosystem. Information evaluated by the technical experts and background materials provided by the NPS are summarized in the sections that follow. Additional detail is provided in "Chapter 3: Affected Environment."

1.4.2 REGIONAL LANDSCAPE-LEVEL CHANGES

Damage at deer browse line

White-tailed deer occur throughout Ohio, as well as most of the contiguous United States. Before European settlement, North American white-tailed deer populations are estimated to have been between 23 and 24 million (McCabe and McCabe 1984). Deer herds throughout the eastern United States were heavily exploited after the arrival of the Europeans around 1600. By 1790, deer populations were low wherever Europeans had settled.

As Ohio was settled, habitat for white-tailed deer was eliminated and hunting was unregulated. By 1900 Ohio was largely deforested, and with no regulated hunting seasons, white-tailed deer in the state had been almost completely eliminated. Ohio closed deer hunting in 1903 in an attempt to save the remaining herd, but by then it was too late; deer were absent from the state from 1904 to 1923. Between the 1920s and 1930s, a deer herd began to develop as a result of the establishment and strict enforcement of hunting laws combined with the natural movement of deer from neighboring states into Ohio (ODNR n.d.a, 2005b).

As a result of low mortality rates due to a lack of predators and increased availability of food and habitat, the deer population has continued to increase. Ohio's deer herd went from being nearly extirpated in 1940 to an estimated 450,000 deer in the fall of 1995 (Iverson and Iverson 1999). Today white-tailed deer occupy all 88 counties in Ohio (ODNR 2009a). In 2011, the fall herd in Ohio was estimated at 750,000 deer (Egan 2011).

Deer browse line

In national park system units in the eastern United States, such as Cuyahoga Valley National Park, landscapes have traditionally been managed to allow for the preservation and rehabilitation of scenic and historic landscapes. The result is a mixture of forest, fields, shrub, and grassland, which constitutes excellent habitat for white-tailed deer. Deer thrive on habitat conditions created by suburban development. New roads, housing, and related enterprises fragment forests and farms and create "edge" habitats that provide plenty of food and ample shelter for deer. Direct impacts from intense browsing include reductions in plant species richness (number of species), plant density and biomass, height growth, and the development of vertical structure. Loss of plant species and vertical structure, leading to the decline of animal species that depend on these plants, represents the primary effect of browsing (Latham et al. 2005).

1.4.3 POPULATION AND ECOLOGICAL CHARACTERISTICS OF WHITE-TAILED DEER AT CUYAHOGA VALLEY NATIONAL PARK

Deer population trends, density, and health at the park have been assessed through a variety of research and long-term monitoring projects since 1990. These research and monitoring projects are described below and in further detail in "Section 3.3, White-tailed Deer."

Spotlight Surveys (1990–present)

Since 1990 annual spotlight surveys have been conducted on nearly 40 miles of roadway, including 8 miles of railroad track, to monitor the park's deer population. These surveys are conducted on 18 road segments, each between 0.35 and 3.5 miles long, and are done every November for five nights over a two-week period. The deer counts are based on eyeshine from a spotlight. Data collected during the survey include the number of deer observed, the presence or absence of antlers, and linear distance of the deer from the road transect (added in 1998). These data provide an index of population trends and a basis for calculating density estimates. Spotlight survey data suggest that the deer population increased steadily between 1990 and 1996, with numbers fluctuating, sometimes dramatically, after 1996 (NPS 2007a; Plona 1999).

Conducting spotlight surveys

Although spotlight surveys are still being conducted, the park determined that reporting the average number of deer seen per night, which was done from 1990 to 2004, was not meaningful for population targets. The park was more interested in determining the deer density using the DISTANCE density estimation method, as described below for "Density Estimation Using Distance Sampling." Therefore, the average number of deer seen per night in spotlight surveys is no longer reported (Petit, pers. comm., 2008a, 2010a).

Density Estimation Using Distance Sampling (1998–present)

Distance sampling methods (Buckland, Anderson, and Burnham 1993; Underwood, Gormezano, and Verret 2003) were added to spotlight surveys in 1998 to derive better estimates of deer population density. This includes counting the number of deer and distance to each animal, providing a more accurate estimate of density than mean numbers over time. By assigning to each group of deer a linear distance perpendicular to the survey segment transect, a sampling area is estimated and a density estimate derived using the statistical program, DISTANCE. The average densities of deer estimated from spotlight surveys between 1998 and 2010 are shown in "Figure 3-6: Average Deer Density per Year at Cuyahoga Valley National Park, 1998–2010" and "Figure 3-7: Average Density of Deer per Zone, 1998–2010" in "Chapter 3: Affected Environment." Parkwide deer density has trended downward since 2002, potentially due to direct reduction actions taken on non-NPS lands within the park, but with some wide fluctuations within different areas of the park. In addition, there was a die-off after the harsh winter of 2005 (Petit, pers. comm., 2008b). Despite the downward trend and fluctuations, current deer densities remain above desired deer density goals defined for this plan/EIS.

Spotlight survey road/railway segments were consolidated into five geographic zones of the park (see Figure 1-2). These zone boundaries were defined along existing divides, such as roads and the river, and are consistent with vegetation monitoring zones. They were developed to logically subdivide spotlight survey routes into relatively equal units that allowed for the best density estimation from spotlight data. Future modification of management zones may result, in order to accommodate for changes in monitoring or management needs (Skerl, pers. comm., 2011). The 2010 deer density estimates for each zone are summarized below and described in more detail in "Section 3.3, White-tailed Deer" (Petit, pers. comm., 2011e).

Zone 1—Approximately 31 deer per square mile.

Zone 2—Approximately 37 deer per square mile

Zone 3—Approximately 36 deer per square mile

Zone 4—Approximately 31 deer per square mile.

Zone 5—Approximately 80 deer per square mile.

Fecal-Pellet-Group Survey (1995–present)

Deer scat

Deer fecal-pellet-group surveys have been conducted at random sites throughout the park to gain information on deer distribution and to estimate deer density. In the winter of 1995–1996, 141 randomly located rectangular plots (each approximately 50 × 3 meters [164 × 10 feet] transects) were sampled, and a contour map of fecal-pellet-group density was produced. An aerial survey was conducted in 10 areas of approximately 0.4 to 0.8 square mile (1 to 2 square kilometers) to determine the deer density associated with each fecal-pellet-group density contour. Data were again sampled in 175 randomly located plots during the winter of 1996–1997. Aerial surveys were conducted by helicopter in the early spring months of 1996 and 1997 to validate fecal-pellet-group survey information (NPS 2007a). Although pellet data continue to be collected, the data are no longer used to derive deer density estimates for the park. In 2001, the park changed the timing of the fecal-pellet-group surveys to coincide with exclosure monitoring, which occurs every 3 years. Therefore, data from the fecal-pellet surveys are no longer analyzed separately as they were in 1995–1997, and are used as a variable in analysis of vegetation changes over time (Petit, pers. comm., 2011a).

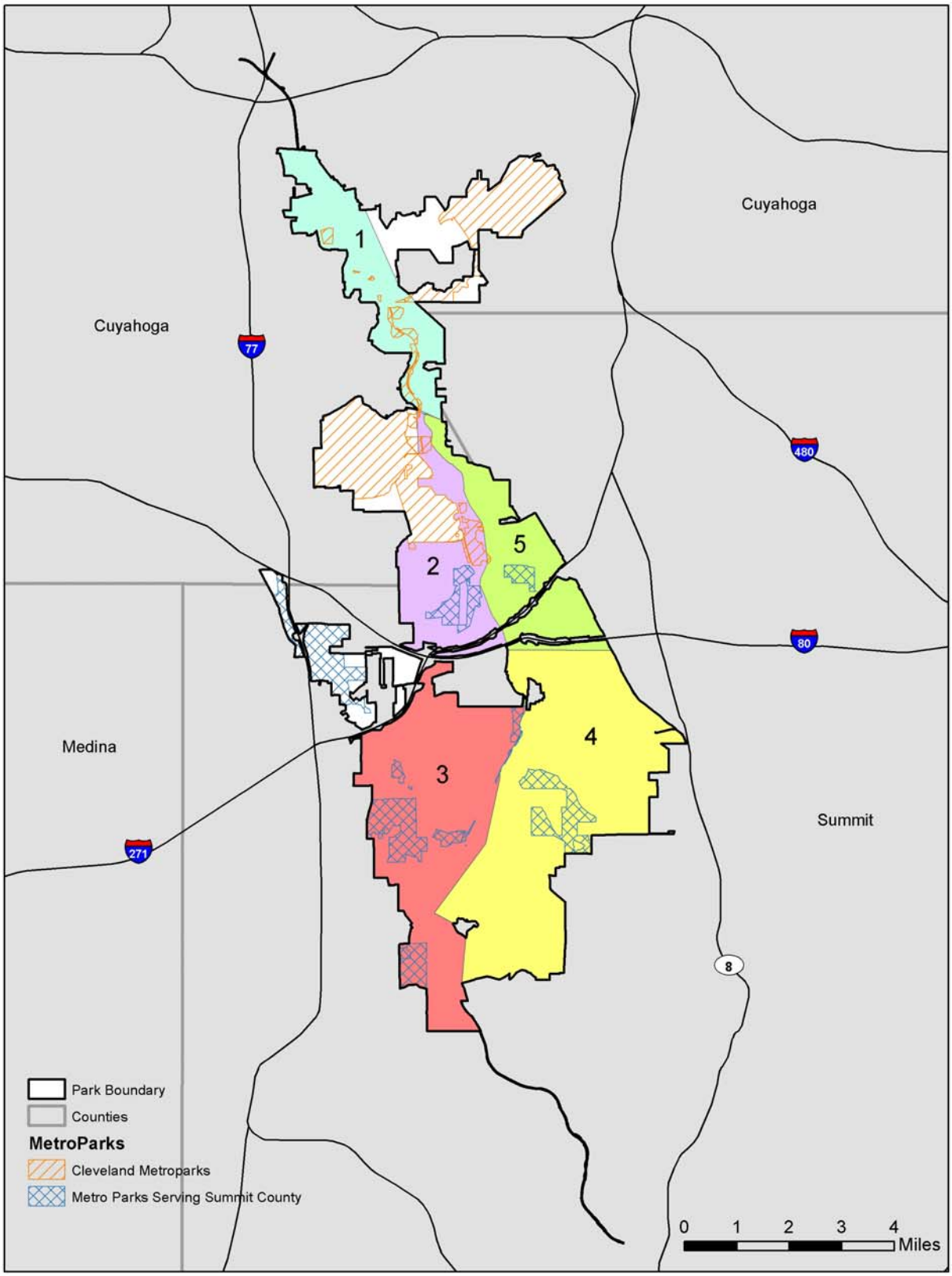


FIGURE 1-2: CUYAHOGA VALLEY NATIONAL PARK DEER MANAGEMENT ZONES

Herd Health (1997–2001)

The U.S. Geological Survey's (USGS) National Wildlife Health Center in Madison, Wisconsin, surveyed herd health between 1997 and 2001. Each year, a sample of 10 deer was taken to assess physiology, blood chemistry, and other physical health factors (USGS 2001). The small sample size precludes meaningful statistical analysis. However, useful comparisons can be made between years and among other deer populations, and over time, assumptions can be made about the general trend of the population (USGS 2001). Results from 2000 show decreases in fat indices, fetal rate, and the twinning rate and reveal that the physical condition of the deer herd had declined from 1999, but still remained above 1997 levels (USGS 2000). Although twinning rate and fetal rate examined in 2001 had decreased from values noted in 2000, the general body condition for deer examined in 2001 was considered in most cases adequate, and one adult doe was in excellent condition considering the time of year (USGS 2001).

Survey results from the 2000 and 2001 USGS reports suggest that if the habitat quality and deer populations remained at current levels, fawn mortality could be expected during periods of extreme winter stress (USGS 2000, 2001). Such weather-related mortality may have occurred at the park in the spring of 2005 (see the "White-tailed Deer" section in "Chapter 3: Affected Environment"), when severe winter conditions and record snow levels occurred from January through March of 2005.

1.4.4 Effects of White-tailed Deer on Vegetation Structure and Species Diversity at Cuyahoga Valley National Park

In addition to determining abundance and distribution of deer at Cuyahoga Valley National Park, the park has been conducting studies to determine the impacts of deer on other natural resources for over 15 years. Studies conducted to date include trillium (*Trillium grandiflorum*) monitoring, studies of paired plots (fenced and unfenced), and long-term ecological monitoring to assess the effects of deer browsing on forest vegetation. The park also studied deer browsing impacts on forest understory birds from 1997 to 2000.

Trillium Monitoring

The park began annual monitoring of deer-browsing impacts on the forest wildflower trillium in 1996. Trillium is a perennial that occurs in the understory of deciduous woodlands throughout the Great Lakes region (NPS 2002a). It is primarily associated with flat, moist areas, and is used parkwide as an indicator of forest regeneration and deer browsing (NPS 2009e).

Trillium monitoring

Currently, 14 trillium monitoring sites are being studied within the park, with a total of 26 paired plots (NPS 2006b). Data collected between 1997 and 2010 demonstrated that stems were consistently taller in exclosures than stems in unfenced areas. From 1997 to 2010, there were 12 years in which average stem heights in unfenced areas fell below the necessary flowering height of 12.5 to 14 centimeters (5 to 5.5 inches) during monitoring, versus 2 years with similar results in exclosures (NPS 2009f; Plona, pers. comm., 2012). Also, trillium flower production was significantly different between exclosures and open plots. Very little flowering was observed in open areas compared to the exclosures; for example, from 2007 to 2010, no flowers were recorded in the open

plots, compared to 28 to 38 flowers in the exclosures (Petit, pers. comm., 2012). Additional information can be found in "Section 3.2, Vegetation."

Forest/Field Exclosure Monitoring

Deer exclosure at Cuyahoga Valley National Park

The park began an exclosure study at three sites in 1991 and expanded the study with 12 additional sites in 1999. Deer impact measurements are based on the 12 newer sites, which were randomly distributed in the park (NPS 2002b; Petit, pers. comm., 2010b). These fenced deer exclosures, each measuring approximately 10 x 10 meters (33 x 33 feet), were paired with equal sized, unfenced plots to analyze the influence of deer on vegetation in various habitats within the park—three pairs in upland forest sites, three in bottomland forest sites, three in upland field sites, and three in bottomland field sites. Measurements of 57 parameters, including species diversity, foliage cover, and seedling regeneration, were recorded in 1999, 2001, and 2005 (forest sites only) (NPS 2007a). Findings indicate that deer are impeding the growth of seedlings in bottomland forests, suppressing native groundcover diversity in upland forests, decreasing the amount of foliage in forests and fields, and enhancing the diversity and density of groundcover in upland fields. Although the impacts on upland fields could be interpreted as a positive effect, this situation could significantly slow the process of succession from open field to young forest by giving field vegetation enough of a competitive advantage that woody species are prevented from becoming established (NPS 2002b). Additional information can be found in "Section 3.2, Vegetation."

Long-term Ecological Monitoring

In 1998 an extensive long-term ecological monitoring system was initiated to monitor changes in vegetation and tree regeneration at 90 locations throughout the park. The same parameters measured in the forest/field exclosures were also measured at these sites. These variables were divided into four main categories: overstory, groundcover, tree regeneration, and vertical structure (NPS 2002c). Site monitoring has occurred on a 3-year rotation, with measurements taken in 2001, 2004, and 2007 (forest sites only). Deer impact level (high or low) was assigned to each site based on the height change of the tallest seedling over time. Based on results from exclosure data, the areas of high deer impact experienced declining seedling abundance, seedling stocking, shrub cover, and groundcover diversity between 1998 and 2001. Impacts were similar in bottomland and upland sites (NPS 2002c). Additional information, including the most recent results of long-term ecological monitoring, can be found in "Section 3.2, Vegetation."

Bird Monitoring

The park conducted a forest songbird study to examine effects of deer relative density and browse on the diversity and abundance of forest songbirds (Petit 1998). A total of 12 study sites (6 in 1997 and an additional 6 in 1998) were established within areas of contiguous, mature, closed canopy forests in the park and in adjacent areas managed by Cleveland Metroparks and MPSSC. Each site was approximately

62 acres and included plant species with similar composition, age, and structure. Sites with high and low deer density numbers supported similar total numbers of bird species, but the overall abundance of individuals was significantly lower in high deer density areas, particularly for species that typically nest and forage in forest understory (Petit 1998). Additional information regarding bird monitoring within the park can be found in "Section 3.4, Other Wildlife and Wildlife Habitat."

1.5 DEER MANAGEMENT AT CUYAHOGA VALLEY NATIONAL PARK

As noted in "Section 1.2.2, Need for Action," the park began to address the issues associated with excessive deer numbers and overbrowsing impacts over 20 years ago. The following describes some of that history leading up to the decision to develop this detailed impact assessment in support of a long-term deer management plan.

In 1993 a deer management task force (DMTF) was established by the Cuyahoga Valley Communities Council to identify the nature and extent of problems caused by deer and to recommend appropriate solutions. The task force included the park (at that time Cuyahoga Valley National Recreation Area), along with 11 representatives from six local municipalities and townships, both municipal park districts (Cleveland Metroparks and MPSSC), the Ohio Farm Bureau, and the ODNR. The purpose of the partnership was to work together to foster communication, realize opportunities, and resolve problems for the mutual benefit of its members (Shafer-Nolan 1997). The task force studied the issue of the deer population within a 178-square-mile area of concern that was centered on the park and included public and private lands. Its recommendations, which were first presented to Cuyahoga Valley Communities Council in 1996 (NPS 2002d), consisted of four methods of deer population control:

- Public sport hunting in areas where legal, practical, feasible, and safe.
- Specially controlled hunting on isolated land areas of greater than 5 acres.
- Sharpshooting in areas not suitable for public sport hunting or specially controlled hunting.
- Capture/euthanasia in developed areas where other methods are not practical or safe (NPS 1997a).

The task force recommended deer population control within the area of concern because

- measures to reduce human conflicts with deer would help, but were not sufficient;
- the extent of damage to residential gardens, landscaping, and farm crops and the number of roadway accidents supported the need to reduce the deer population;
- the density of the deer population exceeded the level at which substantial impacts on natural resources were associated, and it was well within the range at which intolerable conflicts with human activities were associated; and
- there was public support for deer population control. A task force public survey found that 52 percent of respondents agreed that problems warranted control; however, the survey item did not suggest a type of control method (NPS 1997a).

Following the task force recommendations, the NPS completed a *Final Environmental Assessment and Management Plan for White-tailed Deer* (NPS 1997a). On December 10, 1997, the U.S. District Court granted a preliminary injunction against the NPS to prohibit the proposed deer removal from taking place. Shortly thereafter, the NPS withdrew the plan and filed a motion to dismiss the case, which was accepted

by the plaintiffs in the case, the Animal Protection Institute and other animal advocacy groups (*Animal Protection Institute v. Stanton*, Civil Action No. 97-2563; D.D.C. Dec. 10, 1997). However, deer management efforts, primarily sharpshooting activities, have been undertaken by neighboring agencies, including the Metroparks organizations and adjacent municipalities, as described below. Existing planning documents for the park do not specifically address deer management; thus, no deer management actions have been implemented by the park other than the surveying and monitoring actions previously discussed, and the need for a long-range plan still exists due to continued deer-related damage.

Although informal tracking continued following recommendations in 1996, formal existence of the task force ceased and no further recommendations have been made (Petit, pers. comm., 2010c).

1.6 OTHER DEER MANAGEMENT EFFORTS

1.6.1 CURRENT DEER MANAGEMENT IN SURROUNDING JURISDICTIONS

The legislative boundary of Cuyahoga Valley National Park contains many different landowners, including local governments and commercial interests, as well as private landowners. Some landowners have taken and are continuing to take deer management actions within or adjacent to the park. Both the Cleveland Metroparks and MPSSC have taken action to manage deer populations on their lands, including lands that are within the park's authorized boundary. Some local farmers have also received permits from the state to remove deer from their property (Graber, pers. comm., 2006). More information about these activities is provided below.

Metro Parks, Serving Summit County

MPSSC manages 10,000 acres of land (MPSSC 2010a), 3,325 of which are within the legislative boundary of the park (NPS 2009a). In 1993 MPSSC joined the Cuyahoga Valley Communities Council and actively began participation on the DMTF, as previously described. In 1995 the park district developed a plant and animal population management policy, which states that plants or animals will be controlled when they reach unnatural concentrations resulting in unacceptable damage to other species or ecosystems (MPSSC 2006).

Deer densities documented in 1996 were as high as 200 deer per square mile. From 2001 to 2002, MPSSC conducted the first district-wide aerial infrared survey to more accurately determine deer herd sizes. Results showed herds ranged as high as 232 deer per square mile (MPSSC 2006). Only Gorge Park had populations within what is considered an acceptable deer density goal by the park district (MPSSC 2006), which is less than 20 deer per square mile (Johnson, pers. comm., 2010; MPSSC 2006). These studies were continued in 2003, showing results consistent with previous surveys and indicating gross overpopulation in most parks and natural areas (MPSSC 2006).

In 2003–2004, MPSSC initiated a deer herd reduction program within their parks (MPSSC 2006), and by 2008, reduction efforts had been undertaken in eight parks (Johnson, pers. comm., 2008). Between 2005 and 2008, herd reductions occurred in density zones 3 and 5 on lands within the boundaries of the park. A total of 149 deer were removed through sharpshooting from three MPSSC areas within the national park boundary (MPSSC 2006; Johnson, pers. comm., 2008).

Since 2004, sharpshooters have culled more than 1,000 deer in the MPSSC district, and the venison has been donated to the Akron-Canton Regional Foodbank (MPSSC 2010b). In 2008, MPSSC initiated public bow hunting in four areas of Summit County (Folkerth 2008), including zones 2 and 3 of the park, as part of its deer management program (NPS 2009e). In three seasons of the archery program, participants have taken 135 deer (MPSSC 2011a). Although the management program has been successful at reducing deer

herd size, the district's deer density goal of 20 deer per square mile or less was not yet achieved in any of the parks within the district as of 2010 (Johnson, pers. comm., 2010).

Cleveland Metroparks

Cleveland Metroparks manages nearly 21,000 acres of land (Cleveland Metroparks 2009), 4,750 of which are within the legislative boundary of the park (NPS 2009a). Cleveland Metroparks manages 16 land reservations, primarily within Cuyahoga County (Cleveland Metroparks 2009); 2 reservations, Brecksville and Bedford, are within the legislative boundaries of the park (NPS 2009a). In 1993, Cleveland Metroparks began studying deer population problems (Cleveland Metroparks 2006a) and became part of the Cuyahoga Valley DMTF (Shafer-Nolan 1997), and, in 1997, initiated a deer management program with formal deer population surveys (Cleveland Metroparks 2006a).

There are four components of the Cleveland Metroparks deer management program: deer population assessment and monitoring, vegetation assessment and monitoring, deer population control, and communication. The general deer density goal of the program is approximately 15 to 30 deer per square mile; however, more emphasis is placed on the relationship between density and impacts on the environment. Density goals could change based on environmental response. Density estimation techniques include aerial infrared videography (used from 2000 to 2006) and spotlight surveys/distance sampling. To assess and monitor changes in vegetation, photo plots that provide good visual and quantitative data were established in 1997 (Cleveland Metroparks 2006a). Cleveland Metroparks initiated long-term forest vegetation monitoring in 2002, but data from this first year were rejected. Therefore, the park district officially began collecting data in 2003 and continues today. There are currently approximately 1,140 forest vegetation monitoring plots. Approximately 112 of these plots occur within the Bedford reservation, and approximately 107 of the estimated 1,140 plots occur within the Brecksville reservation (Tyler, pers. comm., 2011a).

Cleveland Metroparks initiated a lethal deer-culling program in 1998 that was aimed at reducing the growing deer populations that threatened the biological integrity of native habitats within the park district. The program has been successfully implemented annually since then under the authorization of the ODNR Division of Wildlife and focuses primarily on the removal of female deer (Cleveland Metroparks 2007). Lethal methods of deer population control continue in up to eight reservations within the park district, including Brecksville, Rocky River, South Chagrin, Bedford, Bradley Woods, Mill Stream Run, Hinckley, and North Chagrin. Approximately 3,610 deer total were removed from the eight reservations between 1998 and 2010, averaging approximately 300 deer culled per year. The deer density for Cleveland Metroparks varies within each reservation and varies from reservation to reservation. Since initiation of the deer culling program, the average deer densities for the two reservations located within the boundary of the park (Brecksville and Bedford) have decreased from 70 per square mile (Brecksville) and 110 per square mile (Bedford) in 1997–1998 to 35 per square mile (Brecksville) and 33 per square mile (Bedford) in 2006–2008 (Tyler, pers. comm., 2010).

From 2001 to 2006 Cleveland Metroparks investigated (for research purposes) the efficacy of immunocontraception as an alternative means of controlling deer populations (Cleveland Metroparks n.d.). Porcine zona pellucida (PZP) was delivered to 129 female deer in 2001; results were promising until 2005, when the vaccine failed and reproduction rates increased to levels similar to those seen in the control population. Pregnancy rates increased from 25 percent to 75 percent. A proportion of the treated deer were subsequently removed; 2006 was the last year any deer were culled from the tagged (treated) group (Tyler, pers. comm., 2011a). Cleveland Metroparks concluded that immunocontraception did result in decreased pregnancies. However, the free-ranging nature of the deer herd in the region, where both immigration and emigration take place, makes it difficult to deliver the contraceptive to a large number of deer (Cleveland Metroparks n.d.).

Ohio Department of Natural Resources, Division of Wildlife

The ODNR Division of Wildlife is a regulatory agency that oversees all animals in the state (although the division has no control over land use decisions) and provides a broad range of alternatives for agencies to consider. The goal of Ohio's deer program is to provide a deer population that maximizes recreational opportunity while minimizing conflicts with agriculture, motor travel, and other areas of human endeavor. The division's deer management goal ensures that Ohio's deer herd is maintained at a level that is acceptable to most and is biologically sound (ODNR 2010a). The ODNR Division of Wildlife does not have state-specific deer density goals and avoids the use of specific numbers to define the density goals for each county. However, when number values are placed on the density goals, they are based on the number of bucks harvested per square mile, rather than number of deer per square mile (Tonkovich, pers. comm., 2010).

Historically, the ODNR Division of Wildlife has taken a different approach than the two metro parks organizations in monitoring deer populations, basing their deer management decisions on reported deer/vehicle accidents. However, the agency has chosen to discontinue use of reported deer/vehicle accident data as a metric to track Ohio deer population trends, since recent data suggest that the number of reported accidents may no longer track changes in the size of the deer herd. From 2003 to 2008, the number of reported accidents dropped an average of 5 percent per year. During the same time period, buck harvest generally trended upward (ODNR 2009b).

The division is involved in four ongoing projects in northeast Ohio where deer are being removed from individual counties or cities, including projects for MPSSC and Cleveland Metroparks. The other projects are in the cities of Solon and Pepper Pike, both within a 20-mile radius of the park. Solon began a sharpshooting program in 2005, and more than 1,150 deer were removed between 2005 and 2007. Pepper Pike is performing trapping and euthanasia. In 2005 Pepper Pike had approximately 220 deer within the city, or approximately 30 deer per square mile. Using a private nuisance animal operator, the city removed 178 deer in three seasons (2005–2007) using the clover trap and captive bolt method (Greer, pers. comm., 2011; NPS 2006c).

The ODNR Division of Wildlife also assists other Ohio communities, many of which have implemented controlled hunts. Approximately 12 controlled hunting programs occur in the area around and adjacent to the park, and the programs have been largely successful. Some communities have more recently implemented hunting, and others have been doing so for over 10 years (Peters, pers. comm., 2010). During the 2010–2011 season, a total of 1,973 deer were harvested in Summit and Cuyahoga counties (Tonkovich, pers. comm., 2011). In both counties, the primary method of removal for the past hunting seasons has been archery (ODNR 2009b, 2010a, 2011).

In situations where deer need to be lethally removed to reduce property damage on private land, ODNR Division of Wildlife issues deer damage control permits (DDCP) to landowners/lessees at the time the damage is occurring (ODNR 2010a). As of 2010, 10 private farmers within the park had DDCPs from ODNR to hunt deer within the park's legislative boundary (Peters, pers. comm., 2010). DDCPs are based strictly on property damage; therefore, permits vary in how many deer are allowed to be lethally removed (Greer, pers. comm., 2010).

1.6.2 OTHER DEER MANAGEMENT EFFORTS

Deer Management Efforts within the National Park Service

Other national park system units have been involved in deer management planning efforts. Plans and associated EISs have been completed at Gettysburg National Military Park and Eisenhower National

Historic Site in Maryland, Valley Forge National Historical Park (NHP) in Pennsylvania, Catoctin Mountain Park in Maryland, and Rock Creek Park in Washington, D.C. Deer management planning and environmental review efforts are in progress at Indiana Dunes National Lakeshore in Indiana, Antietam and Monocacy National Battlefields in Maryland, Manassas National Battlefield Park in Virginia, Fire Island National Seashore in New York, and Morristown NHP in New Jersey. The selected alternatives at all parks with completed plans include sharpshooting to quickly reduce the number of deer, and some parks include reproductive control as a maintenance action to be used once the herd has been reduced to the desired deer density (assuming that there is an available reproductive control agent that is effective and meets use criteria established by the parks). Gettysburg has the longest history of deer management, having started with sharpshooting 1995. To date, reducing deer density at Gettysburg has resulted in tree seedling regeneration and recruitment to sapling size and has made a substantial impact on the health of the forest and agricultural crops (Koenig, pers. comm., 2011).

Deer Management and Research by Other State and Federal Agencies

The USDA-WS have been involved in the evaluation and/or implementation of a number of deer management plans on federal properties in the eastern United States. The Agricultural Research Service of the USDA (USDA-ARS) Beltsville Agricultural Research Center has been conducting managed deer hunts since 1995, resulting in an annual average deer removal of 200 to 400 deer (Dudley, pers. comm., 2008, reported in Bates, pers. comm., 2008a). Studies conducted for the states of New Jersey and Virginia concluded that direct reduction of deer populations was the preferred management alternative (U.S. Department of Agriculture-Animal and Plant Health Inspection Service [USDA-APHIS] 2000a, 2000b). In Pennsylvania the resulting management plan included a wide range of management options to assist landowners with deer damage control (USDA-APHIS 2003). A final plan for Ohio resembles the Pennsylvania model, with an integrated wildlife damage management approach that could use nonlethal and lethal methods simultaneously or sequentially (USDA-APHIS 2009).The Maryland Department of Natural Resources issued two permits to conduct reproductive control studies, one to the USDA-WS for research on the effectiveness of GonaCon™ immunocontraceptive vaccine on female white-tailed deer in the White Oaks Federal Research Center in White Oak, Maryland, and the second to the Humane Society of the United States (HSUS). The purpose of the studies was to test the effectiveness of different forms of PZP on female white-tailed deer in the National Institute of Standards and Technologies (NIST) site in Gaithersburg, Maryland. APHIS has been conducting the research at the White Oak site, which is about 1 square mile in size and has a fenced perimeter that is relatively impermeable to deer. In 2004, female deer were individually darted with an immobilization drug and then treated with a gonadotropin releasing hormone (GnRH) vaccine, GonaCon™. Twenty-five does were treated and 15 does were marked as a control group. Each doe received a radio collar and an ear tag. During the spring following initial treatment, 11 out of 15 control animals had fawns, whereas only 3 out of the 25 treated does gave birth. In the second year at White Oak, more than half (54 percent) of the treated does gave birth (Bates, pers. comm., 2008b; Gionfriddo et al. 2009).

1.6.3 OTHER VEGETATION MANAGEMENT ISSUES

Invasive Nonnative Plant Species

Invasive nonnative plants pose a significant threat to the integrity of natural ecosystems across the United States. Spread of these species may impact native plant and animal communities by reducing the amount of light, water, nutrients, and available space. These changes in the native plant community can decrease habitat quality for native wildlife; alter hydrological patterns, soil chemistry, moisture-holding capacity, and erodibility; and cause changes in the fire regime (Randall 1996). The nonnative problem is particularly acute in urban parklands where extensive forest fragmentation and creation of “edge”

environments, frequent human disturbance, and high deer densities enhance opportunities for invasive, nonnative plants to become established (NPS 2004a).

In 2007, a parkwide invasive plant monitoring program was initiated through the NPS Heartland Inventory and Monitoring Network. A total of 47 nonnative invasive plant species were detected and mapped within the park in the first year. Three of these plant species were not previously documented as occurring in the park, and four of the 47 species were very widespread, occurring in more than 40 percent of transects: multiflora rose, garlic mustard, European privet, and Japanese barberry. Multiflora rose, the most abundant invasive plant at the park, covered between 20.4 and 436.5 acres. Of the 47 invasive plant species, 37 species occurred in less than 18 percent of transects and five species occupied less than 1 acre (Djuren and Young 2007). Additional information regarding the park's invasive nonnative plant species and results from this inventory can be found in "Section 3.2.3, Invasive, Nonnative Species."

Executive Order 13112, "Invasive Species," requires federal agencies to control populations of such species in a cost-effective and environmentally sound manner. However, the NPS does not currently have the resources to eradicate these species from the park. Invasive plants spread from seed sources from many areas around the park, making eradication unlikely. Rather, the park focuses on removing invasive plant species from sensitive areas such as rare plant habitats, wetlands, stream corridors, and other important natural areas. The park is working first in areas with important natural values and small amounts of invasive plants. Over time, these less infested areas will be kept clear of high concentrations of invasive plants. The park will then begin work in areas of heavier infestation as resources become available to do so (NPS n.d.i).

In the case of invasive plants that are not susceptible to manual control, park staff uses herbicides to ensure more effective control. These chemicals are used according to product labels to avoid adverse ecological effects. Areas managed to date have shown a great ability to recover after removal of invasive plants. Areas that are severely infested—for instance, by large populations of Japanese knotweed—are less likely to be restored to natural plant communities by simply keeping invasive plants out. Planting with native herb, shrub, and tree species may be required in such areas due to a lack of native seed sources, intense competition, or other factors. If necessary, plans will be made for more intensive restoration activities in these areas (NPS n.d.i).

The park has developed the Exotic Plant Management Removal Program, which is a volunteer-based, long-term invasive plant monitoring and control program. This program features the adoption of sections of the park by volunteers who are trained to look for and control invasive plants (NPS 2009g, 2010b). In addition, in 2010, an exotic plant management team (EPMT) was established through the Heartland Inventory and Monitoring Network to focus on large-scale treatment of exotic plant infestations in prioritized areas within the park (Petit, pers. comm., 2010b).

Pests and Disease

Outbreaks of insect herbivores or diseases in Ohio's forests have caused mortality of important forest species, and threaten the park's natural and scenic resources. For example, 4,000 acres of forest in the park were defoliated by the gypsy moth (*Lymantria dispar*) in 1999. Park staff, volunteers, university researchers, local organizations, and other agencies help monitor these and other environmental concerns to identify problems, establish trends, and assist in management decisions. Insect and disease problems identified that may impact forested communities in the future are gypsy moth and emerald ash borer (*Agrilus planipennis*) (NPS 2006d, 2008a).

Gypsy Moth

Gypsy moth is the most obvious and widespread defoliating insect of hardwoods in the northeastern United States. An exotic insect from Europe, the moth has been advancing into Ohio from Pennsylvania and Michigan over the past decade (Ohio Department of Agriculture [ODA] n.d.a). Gypsy moths target a number of tree species found in the park, including oak, which is a substantial component of Cuyahoga Valley forests (approximately 70 percent of forest cover). Other targeted habitats found in the park include river birch (*Betula nigra*), hawthorn (*Crataegus* spp.), and willow (*Salix* spp.). Moderately desirable species that can be defoliated by gypsy moth include cherry (*Prunus* spp.), cottonwood *(Populus* spp.), elm (*Ulmus* spp.), blackgum (*Nyssa sylvatica*), hickory (*Carya* spp.), hornbeam (*Carpinus* spp.), maple (*Acer* spp.), and sassafras (*Sassafras albidum*) (NPS 2000a). Gypsy moth caterpillars feed on the leaves of these hardwood trees and can cause complete defoliation of a tree, affecting the vigor and general health of forests, and sometimes leading to tree death (NPS 2000a).

Defoliation and the loss of mature trees can change forest and understory composition, water quality in streams and lakes, and the quality and availability of food for terrestrial and aquatic wildlife. These changes can alter the abundance and distribution of wildlife (NPS 2008b). Since the defoliation of 4,372 acres of forest in the park in 1999, the park has implemented a suppression program to help minimize and mitigate further moth defoliation effects (NPS 2000a). In addition, the USDA Forest Service (USFS) conducts aerial surveys to quantify gypsy moth defoliation on an annual basis (NPS 2000a). No evidence of significant gypsy moth infestation has been documented within the park since 2001.

Emerald Ash Borer

Arriving in North America from Asia in the 1990s, the emerald ash borer is a beetle that attacks and kills ash (*Fraxinus* spp.) trees. This species was found in Ohio in 2003 and the USDA has enforced quarantines in several states, including Ohio (USFS et al. 2010). Quarantines help slow the spread of the borer to uninfested parts of the country by prohibiting the movement of all hardwood firewood and ash tree materials. Since emerald ash borer was first discovered in Ohio, the ODA has placed 67 counties under quarantine, including those in and adjacent to the park (NPS 2008b; ODA 2010). The only method for controlling the emerald ash borer is to cut and burn all trees within a 0.5-mile radius of an infected tree. There currently is no effective alternative treatment available to managers of large natural areas (NPS n.d.h; Skerl, pers. comm., 2011).

Fire

Two goals of the park's wildland fire management plan (FMP) are to prevent and minimize impacts of unwanted wildland fire and to support the park's landscape vegetation goals. The park will manage fire in a manner that protects human life and property, suppresses all wildland fires efficiently with the least adverse impact on resources, protects park cultural resources while maintaining a natural setting, and achieves vegetation and cultural resource management goals (NPS 2004b).

In April 2012, the park conducted a prescribed fire in Boston Township off Boston Mills Road just south of Interstate 80. The burn was conducted to maintain native plant species and prevent the spread of invasive woody brush. Prescribed fire has been used for 30 years within the boundaries of Cuyahoga Valley National Park by Cleveland Metroparks to manage habitat and control invasive species. However, this was the first prescribed burn coordinated by the NPS on park lands (NPS 2012).

The focus of prescribed fire is vegetation and habitat management, with reduction of hazard fuels resulting from and compatible with the vegetation objectives. If fire is intended to restore native vegetation, then it should be used every 3 to 5 years and restoration efforts must be made to reseed or

overseed areas where native grasses are sparse after the first use of fire. Additional measures may be taken to further control invasive species. The park may use fire to stall or halt ecological succession without making restoration to native grassland the primary goal. The park could use fire on a 6- to 7-year rotation if the goal is to suppress ecological succession (NPS 2004b).

Beaver

The return of beaver to the park in the early 1990s produced both positive and negative impacts on the park and its neighbors. The park developed a beaver management plan in 1992 to assess the impacts of beaver and to develop management options for dealing with beaver-related problems (NPS 1992b). The wetlands constructed and maintained by beavers for their own protection also provide a range of habitats suitable for many plant and animal species. Any increase in beaver numbers contributes to an increase in habitat for those species dependent on wetlands, including many bird, mammal, reptile, amphibian, fish, and invertebrate species (NPS 1992b).

Beavers typically become a problem when their tree-cutting or pond-construction activities adversely affect important resources or developments inside or outside the park. While this primarily involves flood damage and other water-related issues, tree-cutting and feeding activities could damage or threaten valuable or protected plants. Management actions identified in the beaver management plan to protect trees include placing hardware cloth or fencing fabric around the base of trees. This has been an effective and relatively inexpensive technique, with only a small visual impact. Repellents (chemical or beaver scent) can also be applied to the base of trees to discourage gnawing (NPS 1992b).

Periodic surveys of beaver abundance in the park indicated that the population has remained relatively stable or possibly declined since 1992. A survey in 2012 estimated a total of approximately 60 beavers within the park (Petit, pers. comm., 2012).

1.7 SCOPING PROCESS AND PUBLIC PARTICIPATION

Regulations implementing NEPA require an "early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action." To determine the scope of issues to be analyzed in depth in this plan, meetings were conducted with park staff and other parties associated with preparing this document. As a result of this scoping effort, several issues were identified as requiring further analysis in this plan/EIS. These issues represent existing concerns as well as concerns that might arise during consideration and analysis of alternatives. The scoping process is fully described in "Chapter 5: Consultation and Coordination."

Scoping—an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action.

The issues and impact topics developed during scoping are presented further in "Section 1.8, Issues and Impact Topics." These issues formed the basis for the impact topics discussed in Chapters 3 and 4 of this plan/EIS.

1.7.1 SURVEY OF SOCIAL ATTITUDES TOWARD DEER MANAGEMENT

The University of Minnesota conducted a study (Dougherty, Fulton, and Lime 2001; Fulton et al. 2004) to quantify the social attitudes of residents adjacent to and farther from the park. This study found that the majority of the respondents supported deer management, including lethal methods. Overall, respondents indicated that not taking action was generally unacceptable. Lethal control was more acceptable to most respondents than taking no action, with the majority saying that lethal control was slightly, moderately, or

very acceptable. However, one-fifth to one-quarter of respondents said that lethal control was unacceptable. The majority of respondents trusted the NPS in its decision making on this issue. Respondents said that moderately or very beneficial potential outcomes included reducing the risk of deer/vehicle collisions; reducing the damage done by deer to shrubs, crops, and gardens; reducing the risk of diseases; and maintaining a healthy deer population. The majority also said that reducing damage done by deer to native plant and animal species and helping maintain a diversity of plant and animal species were also beneficial potential outcomes (Fulton et al. 2004).

1.7.2 INTERNAL SCOPING AND PLANNING

An internal scoping meeting was held on October 23 and 24, 2003, to initiate the plan/EIS process. Attendees included park officials, representatives from the NPS Midwest Region Office, the NPS Environmental Quality Division (EQD), and NPS consultants. Discussions at the meeting were focused on the management of deer as part of a healthy and functioning ecosystem at the park. The goal of this meeting was to determine the purpose, need, and objectives for managing deer at the park, as well as to identify issues and concerns associated with the deer populations and their impact on the park ecosystem. Preliminary alternative management strategies were also discussed. A second internal scoping meeting was held on February 22, 2006, during which the planning team reaffirmed the purpose and need for the plan, incorporating the latest information available, and discussed planning for the public meetings. The team confirmed the plan objectives, issues and impact topics, and preliminary alternatives.

The planning team met again on March 14 and 15, 2007, to select and develop the alternatives that are considered in this plan/EIS. The group reviewed the management strategies that were developed during internal scoping and discussed during the public meetings that were held in October 2006. The internal scoping process is documented in reports that are available in the administrative record and is further described in “Chapter 5: Consultation and Coordination.”

1.7.3 SCIENCE TEAM

In addition to internal scoping, the NPS assembled a science team to evaluate scientific literature and research on the topic of deer management and to provide technical support for establishing a monitoring protocol for park deer populations and other park resources and a basis for the resource thresholds at which deer management strategies would be implemented. The team was composed of scientists and other specialists from a variety of state and federal government organizations (see “Section 5.5, List of Preparers and Consultants”). The first science team meeting was held on February 23, 2006, and meetings occurred periodically thereafter over the next year, providing technical background information and research references for this plan/EIS. Science team meeting notes are included in the administrative record for this plan/EIS.

1.7.4 PUBLIC SCOPING AND OUTREACH

The notice of intent (NOI) to prepare the plan/EIS was published in the Federal Register on September 6, 2006 (Volume 71, Number 172). The publication of the NOI represented the initiation of the project and the beginning of the public scoping and outreach process. Since this time, the park website (www.nps.gov/cuva) has provided up-to-date information on the project process, made available public documents, and solicited input on the project.

On October 11 and 12, 2006, three public meetings were held: one on October 11 and two on October 12. The purpose of the scoping meetings was to begin public involvement early in the planning stage and to obtain community feedback on the initial concepts for deer management at Cuyahoga Valley National Park. The open-house-style meetings included a brief presentation and display boards that illustrated the

project background; draft purpose, need, and objectives; park research; and preliminary concepts for deer management at the park. NPS personnel or contractors were available to answer questions or concerns of community members and to record comments. Comment sheets were also provided to meeting attendees as an additional method for providing comments. Additionally, meeting attendees were also directed to the EIS brochure, which provided information on other opportunities to comment on the project, including submitting comments through the NPS Planning, Environment, and Public Comment (PEPC) website at http://parkplanning.nps.gov/cuva. During the three meetings, a total of 91 attendees signed in.

The 60-day public comment period began with publication of the NOI in the Federal Register on September 6, 2006. Public comments were analyzed and a public scoping comment analysis report was created, which is now on file as part of the administrative record. Additional information regarding public scoping is available in "Chapter 5: Consultation and Coordination."

1.8 ISSUES AND IMPACT TOPICS

1.8.1 IMPACT TOPICS RETAINED FOR FURTHER ANALYSIS

The issues discussed by the interdisciplinary team are presented below. These issues formed the basis for the impact topics discussed in Chapters 3 and 4 of this plan/EIS.

Vegetation

An overabundance of deer could possibly alter and affect forest regeneration patterns in the park, as well as the diversity of species within the park, by reducing the understory and affecting the natural diversity of dominant tree species. The park has conducted studies, including monitoring trillium exclosure plots and forest/field exclosure plots, as well as long-term ecological monitoring, to study the impacts of deer on park vegetation. These studies consistently show that in areas of high deer density, there are greater impacts on vegetation. Continued deer browsing and other deer activities are inhibiting forest regeneration and are changing the composition of the understory. Deer browsing is inhibiting seedlings from growing, potentially increasing the survival of less palatable species and altering forest composition. Furthermore, the trillium exclosure plot monitoring studies found that due to protection from deer browsing, individual trillium plants inside exclosures had a greater probability of flowering than those outside exclosures.

Increased deer activity can promote nonnative species through selective browsing, habitat alteration, and seed dispersal. An increase in nonnative species could have a negative impact on the park's native plant communities. Deer activities, such as browsing, trampling, and seed dispersal through waste or attachment to hair, have the potential to increase the number and type of nonnative species within the park (Myers et al. 2004; Vellend 2002; Williams and Ward 2006; Willson 1993). As the number of nonnative species increases, the native species within the park encounter increased competition and are adversely affected.

Deer management activities could result in areas of increased deer use, if bait is used to attract deer to a particular area. This could have a disproportionate impact on vegetation in areas near established bait piles. In addition, fencing that keeps deer away from vegetation results in increased browsing pressure outside the fenced area as well as decreased browsing pressure inside the fenced area.

White-tailed Deer

Maintaining a viable deer population while protecting other park resources within the park is imperative to this plan. Cuyahoga Valley National Park has monitored the population trends and density of the deer

population through spotlight counts, distance sampling, and fecal-pellet-group surveys. Survey results indicate an overabundance of deer. Although high deer densities may adversely affect plants and other wildlife species, deer themselves are an important park resource. It is important that this plan maintain a deer population in the park while taking action to reduce adverse effects on the deer population itself.

In addition to the reduction in the population, the proposed actions may also impact the movement and behavior of the deer population. Fencing, the use of darts for fertility treatments, or any lethal actions could cause deer to avoid certain areas in the park. This could result in higher competition for areas that were not targeted and increased movement across the park boundary. Implementation of certain reproductive controls also could result in physiological and behavioral changes within the deer population such as repeated estrous cycles and an extended mating season.

Chronic wasting disease (CWD), although not found in Ohio, is a potential future concern for the park and its deer. CWD is a fatal neurological disease that affects behavior and body condition and has been identified in both free-ranging and captive white-tailed deer, mule deer, elk, and moose. The closest known case of CWD is in white-tailed deer in West Virginia, approximately 200 miles from the park boundary. While much is still unknown about the spread of the disease and the long-term effects, there is currently no evidence that the disease can be transmitted to humans or domestic livestock. The Disease Diagnostics Laboratory of the ODA Division of Animal Industry is working with the Ohio departments of natural resources and health, as well as the USDA, to test and monitor Ohio's deer herd using opportunistic and targeted sampling for evidence of CWD (ODA n.d.b).

Other Wildlife and Wildlife Habitat

At certain levels, deer overabundance adversely affects other wildlife and/or habitat by reducing habitat quality through activities such as browsing, trampling, and seed dispersal. Studies have linked high deer densities to undesirable effects on other wildlife species, such as migratory birds (deCalesta 1994; McShea 2000; McShea and Rappole 2000). A study in 1996–1997 at the park documented impacts of deer density on forest songbirds, showing that in areas of high deer density, the abundance of songbirds was less than in low-density areas (Petit 1998). In addition, deer can also affect small mammal populations through competition for food such as acorns (McShea and Rappole 2000). Conversely, some evidence suggests that certain disturbance-tolerant invertebrates may thrive in areas browsed by deer, elevating the numbers of generalist snakes and salamanders that prey on those invertebrates (Greenwald, Petit, and Waite 2008).

Deer management activities could also impact other wildlife and wildlife habitat. The use of bait piles could provide an additional food source for some species, while fencing could restrict access to certain wildlife habitat. In addition, the presence of increased human activities and associated noise during specific time periods could result in temporary behavior changes and the avoidance of management areas.

Special Status Species

There are two federally listed animal species confirmed to occur within the park, but these have been dismissed from detailed analysis (see "Section 1.8.2, Issues and Impact Topics Considered but Dismissed from Further Analysis"). There are, however, 59 state-listed animals that are known to occur within the park; the term "state-listed" includes species that are listed by the state as endangered, threatened, species of concern, and special interest. Many of these species could be affected to a greater extent by the impacts of overbrowsing on vegetation or by deer management actions because they nest or feed/forage on the ground or in the understory of the forest, or because they are grassland inhabitants that could benefit from deer browsing effects. Special-status animal species confirmed within the park are listed in Appendix A and addressed in Chapters 3 and 4 of this plan/EIS.

Habitat for special-status plants (state-listed threatened or endangered species, rare and unusual species, or species of special concern) may be vulnerable to impacts from high levels of deer browsing. One federally endangered or threatened plant that occurs in Summit County was of potential concern, but that species (northern monkshood) does not occur in the park and was dismissed from further analysis (see "Section 1.8.2, Issues and Impact Topics Considered but Dismissed from Further Analysis"). However, there are currently 39 plant species confirmed within the park that are state-listed special-status species (Plona, pers. comm., 2011), and the majority of these could be affected by deer overbrowsing and/or deer management actions. Special-status plant species confirmed within the park are listed in Appendix A and addressed in Chapters 3 and 4 of this plan/EIS.

Rural Landscapes

In some cases the presence and activities of high numbers of deer may affect the character of the rural landscape of the park. The rural landscape is a type of cultural landscape, which is a type of cultural resource. A cultural landscape is defined by the Secretary of the Interior's standards as a geographic area (including both cultural and natural resources and the wildlife or domestic animals therein) associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values (NPS 1996). Cultural resources at the park have been characterized into six primary cultural themes: prehistoric and indigenous cultures, agriculture, transportation, settlement, recreation, and industry (NPS 1987, cited in NPS 2003). Rural landscape is the term given to the cultural landscape resources at the park that have an agricultural theme.

Rural farmland

According to the Rural Landscape Management Program / EIS, the rural landscape is a landscape that exhibits the historic activity as well as the cultural and aesthetic values associated with agriculture, and is physically characterized by the spatial organization and land use patterns created by contrasting patterns of farmsteads, hardwood forests, open meadows, row crops, and pastures (NPS 2003). The rural landscape management program is being implemented under the Countryside Initiative Program, which involves rehabilitation and revitalization of 20–25 farms over a period of 10–15 years. Certain deer management activities that result in fence construction or landscape alteration (e.g., vegetation changes) could impact the park's rural landscapes.

In addition, the park contains the Virginia Kendall State Park Historic district, which is "the premier historic designed landscape" of the park (NPS 2000c), and it is a significant cultural landscape contributing to the cultural resource theme of recreation. Deer can negatively impact vegetation in designed wooded areas such as this historic district and consequently affect its recreation purpose and cultural value.

Socioeconomic Resources/Adjacent Lands

Impacts from deer browsing could affect park neighbors, as well as farmers who are leasing NPS land under the park's Countryside Initiative Program, by causing damage to landscaping and crops, which would have economic consequences. In addition, there are concerns relating to transmission of disease from deer to domestic animals on local farms. Damage to landscaping from deer could result in the need to replace ornamental vegetation, causing aesthetic and economic impacts. At least three farmers leasing property under the park's Countryside Initiative Program have erected fences to protect crops from deer.

Fences are expensive for the farmers, but essential to farming in the park. Dogs are also used within fenced fields to keep deer out.

Visitor Use and Experience

If deer management activities were to decrease the number of deer in the park, chance sightings by visitors would also decrease. Some visitors to the park may view deer sightings as an integral part of their visit. Deer management actions may decrease the potential for visitors to observe deer within the park, causing less visitor satisfaction. Conversely, an overabundance of deer may have an indirect impact on other park visitors by altering the habitat of other species (i.e., changing the understory so that there are fewer migratory birds) and changing the visitor experience for those visitors who come to see species within that habitat. Increased deer browsing has the potential to impact these other resources and impact the satisfaction of these visitors.

Proposed deer management activities may require certain areas of the park to be closed to the general public during management activities, affecting visitor use and experience as well.

Visitor, Employee, and Volunteer Health and Safety

Various health and safety concerns could result from implementation of the alternatives described in this plan/EIS. There has been one incident related to a hunter outside the park shooting an arrow across a towpath, but no accidents have occurred to date (Petit, pers. comm., 2011b). Health and safety applies to park visitors, local residents, and park employees and volunteers. All deer management activities would need to be conducted in a manner that would ensure the safety of park visitors, employees, and volunteers.

A primary safety issue for visitors and local residents related to this plan involves injuries from deer/vehicle collisions. High densities of deer could affect the safety of visitors, employees, and volunteers using park roads. Several studies have shown that deer/vehicle collisions increase as local deer populations increase (DeNicola and Williams 2008; Rutberg and Naugle 2008). One study in Ohio concluded that factors such as population sizes, traffic volume, habitat, and time all influence the incidences of deer/vehicle collisions in Ohio (Schwabe et al. 2000).

Deer-related diseases may pose health risks to park visitors or area residents. Deer ticks carry Lyme disease, and the Centers for Disease Control and Prevention (CDC) have stated that abundant deer and rodent hosts are necessary to maintain the enzootic cycle for the spirochete *Borrelia burgdorferi*, the agent for Lyme disease. Though the deer cannot transmit the disease to humans or ticks, a high deer population provides more hosts and there is concern that this could support a higher than normal tick population compared to lower deer densities

Park Management and Operations

Deer management activities have the potential to impact staffing levels and the operating budget necessary to conduct park operations. Park management and operations refers to the current staff available to adequately protect and preserve vital park resources and provide for an effective visitor experience. Natural resource management staff currently devote about 10–15 percent of their time to deer management activities, which include annual fall spotlight surveys, vegetation monitoring, and data management and analysis, and they would have even more responsibilities under any of the alternatives considered. Additional deer management activities undertaken by park staff could affect other areas of park operations.

Deer management activities must take into consideration the deer management actions of adjacent municipalities to enhance deer management success within the park. Cuyahoga Valley National Park is an urban park with multiple jurisdictions as neighbors, including Cleveland Metroparks and MPSSC. Both Cleveland Metroparks and MPSSC have taken action to manage deer populations on their lands, including lands that are within the park's legislative boundary. Furthermore, lands within the park boundary include many different landowners, including local governments, commercial interests, and private landowners. Due to the intricate mix of land uses and landownership within the park, as well as the management activities that are being undertaken by the Cleveland and Summit County park agencies, deer management actions at the park will require staff time for coordination with the appropriate local and private entities.

Park interpretive or educational staff would also need to allocate additional time and resources to enhance public awareness and understanding of NPS resource management issues, policies, and mandates as they pertain to deer management. Implementing deer management activities would require park staff to conduct public outreach efforts.

1.8.2 ISSUES AND IMPACT TOPICS CONSIDERED BUT DISMISSED FROM FURTHER ANALYSIS

The following issues were reviewed and subsequently eliminated from further discussion because potential deer management strategies would cause few, if any, changes to these resources.

Geohazards

A geohazard is an event related to geological features and processes that would cause loss of life and severe damage to property and the natural and built environment, such as an earthquake or rockslide. There are no known geohazards within the park that would be affected by deer management activities or that would affect deer management activities.

Soundscapes

Management strategies, especially sharpshooting, could affect visitors and wildlife because of associated noise. Population and vegetation monitoring activities along with the construction/maintenance of fencing would be consistent with the park's current ambient (i.e., background) noise levels. The impacts would be limited mainly to the temporary displacement/disturbance as a result of the noise associated with these activities. As a result, the impacts would be long term, negligible, and adverse. Minimal noise impacts would be expected from administering reproductive control options. There would be some noise resulting from vehicles used to set up bait stations, construction activities to set up holding pens, and firing of dart guns. The noise generated by these activities would likely result in temporary, localized disturbance only. For those alternatives that include the use of firearms, any firearm noise would be temporary, and it is unlikely that firearm noise would be substantial. Although firearm use could occur at night, when background noise is reduced, suppressors would be used to reduce noise from firearm discharges. In addition, deer management activities encompassing firearm use would occur primarily during late fall and winter months, when fewer visitors are in the park. Due to the urban setting of the park and the large amount of through-traffic, natural sounds are masked, and any sounds associated with deer management actions would not cause a noticeable change to the existing sound levels. Because noise impacts related to deer management would be short term, very localized, and negligible to minor, the impact topic of soundscapes was dismissed from detailed analysis.

Air Quality

Section 118 of the 1963 Clean Air Act (42 USC 7401 et seq.) requires a national park system unit to meet all federal, state, and local air pollution standards. Further, the Clean Air Act provides that the federal land manager has an affirmative responsibility to protect air quality–related values (including visibility, plants, animals, soils, water quality, cultural resources, and visitor health) from adverse pollution impacts. NPS *Management Policies 2006* directs parks to seek the best air quality possible in order to "preserve natural resources and systems; preserve cultural resources; and sustain visitor enjoyment, human health, and scenic vistas" (NPS 2006a).

Deer management activities as described under the proposed alternatives would result in few impacts on air quality. Although some activities, such as vehicle and gun use, can create small amounts of emissions, these would be very limited and short term, resulting in only negligible impacts on regional air quality. Therefore, air quality was dismissed as an issue.

Marine or Estuarine Resources

There are no marine or estuarine resources in this inland park.

Energy Resources

The implementation of a white-tailed deer management plan would not be expected to affect energy resources or resource conservation within the park.

Prime or Unique Farmland

No "unnecessary and irreversible conversion of farmland to nonagricultural uses" (Farmland Protection Policy Act of 1980) is expected under this plan. Thus, no impacts on prime and unique farmlands are expected.

Geothermal Resources

No geothermal resources exist within the park's boundaries.

Paleontological Resources

Paleontological resources (fossils and their associated data) are a major source of evidence of past life. They are the basis for our understanding of the history of life on Earth, and are an integral part of our planet's biodiversity. In Cuyahoga Valley National Park, paleozoic units within the park span the upper Devonian, Mississippian, lower Pennsylvanian and are composed of two groups and five geologic formations dominated by sandstone, shale, limestone, and dolomite (NPS 2008c). Although these sites are within the park, paleontological resources would not be affected by deer management. Therefore, potential impacts to paleontological resources from the alternatives under consideration in this plan are not analyzed in detail.

Floodplains

The NPS *Procedural Manual 77-2: Floodplain Management* (NPS 2002e) provides agency-specific guidance for implementing Executive Order 11988, "Floodplain Management." According to the guideline, an action class and applicable regulatory floodplain must be identified for a proposed action that is either subject to possible harm from flooding or has the potential for adverse floodplain impacts.

No occupancy, modification, or development of floodplains is expected under this plan. The removal of ground vegetation through deer browsing could increase stormwater runoff, which could contribute to flood events. However, the expected increase in runoff due to browsing would be negligible. Therefore, this topic was dismissed from further analysis.

Cultural Resources Other than Rural Landscapes

The term "cultural resources" includes historic structures/districts, archeological resources, museum collections, ethnographic resources, and cultural landscapes. As mentioned before, cultural resources at the park have been characterized into six primary cultural themes: prehistoric and indigenous cultures, agriculture, transportation, settlement, recreation, and industry (NPS 1987, cited in NPS 2003). Rural landscapes, a type of cultural landscape representing the agricultural theme, are included for detailed analysis in this plan/EIS, as previously noted. In addition, the Virginia Kendall Historic District, which is a recreational cultural landscape, will also be evaluated as previously noted. All other districts are dismissed from consideration because deer management would have no measurable effect on the districts. The other types of cultural resources of the park that were dismissed from detailed analysis are listed below, with explanations for the dismissals.

Historic Structures

According to the Director's Order 28: Cultural Resource Management, structures are defined as material assemblies that extend the limits of human capability. In plain language, this means a constructed work, usually immovable by nature or design, consciously created to serve some human activity. Examples are buildings, monuments, dams, roads, railroad tracks, canals, millraces, bridges, tunnels, locomotives, nautical vessels, stockades, forts and associated earthworks, Indian mounds, ruins, fences, and outdoor sculpture. Although the park does contain historic structures, they would not be affected by deer browsing impacts or by proposed actions related to managing deer.

Archeological Resources

Archeological resources, a type of cultural resources, are the remains of past human activity and records document the scientific analysis of these remains. Implementation of some of the proposed actions that involve ground disturbance would have the potential to disturb archeological resources, but measures would be taken to avoid or minimize adverse effects. Specifically, archeological surveys will be conducted and any proposed fencing would be located away from known sites. Additionally, construction monitoring would occur in potentially sensitive areas subject to subsurface excavation. Should any archeological resources be discovered, fencing installation would stop. Deer entrails would be buried only if there is an appropriate location that would not disturb archeological sites or potential resources, e.g., a previously disturbed area; otherwise, the entrails would be taken off site in barrels. Deer carcasses and waste not suitable for donation for consumption or for surface disposal would continue to be disposed of at an approved local landfill, not on site. Therefore, because any impacts on park archeological resources as a result of deer management activities would be negligible, this topic was dismissed from further analysis.

Museum Collections

Museum collections (i.e., objects housed and preserved in NPS institutions for essentially educational or aesthetic purposes) are a type of cultural resource. No museum collections would be affected by any of the proposed actions.

Ethnographic Resources

An ethnographic resource is a type of cultural resource under NPS stewardship that is of cultural significance to peoples traditionally associated with it. In other words, the resource is "closely linked to [the peoples'] own sense of purpose, existence as a community, and development as ethnically [and occupationally] distinctive peoples." No ethnographic resources or issues have been identified at the park; thus, impacts cannot be evaluated.

Cultural Landscape Themes- Prehistoric and Indigenous Cultures, Settlement, Transportation, and Industry

Cultural resources at Cuyahoga Valley National Park have been categorized into six primary cultural themes that identify a resource by its primary historical significance; these include prehistoric and indigenous cultures, settlement, transportation, recreation, agriculture, and industry. For this document, the cultural landscapes with the themes of agriculture and associated recreation would be addressed under the term Rural Landscape, which is a topic that is analyzed in detail in this EIS. Rural landscapes are landscapes that exhibits the historic activity as well as the cultural and aesthetic values associated with agriculture (NPS 2003), and as such would include these themes. The other cultural landscapes themes identified above were dismissed from detailed analysis because deer or deer management actions (primarily changes in vegetation) would not have a measureable effect on these landscape themes, and actions such as deer removal or fencing would not affect landscapes primarily associated with these themes.

Indian Sacred Sites

This plan would not restrict access to Indian sacred sites for ceremonial uses.

Environmental Justice

Executive Order 12898: "Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations" requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high or adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. Guidelines for implementing this executive order under NEPA are provided by the Council on Environmental Quality (CEQ) (CEQ 1997a). According to the EPA, environmental justice is defined as

> The fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. The goal of this "fair treatment" is not to shift risks among populations, but to identify potentially disproportionately high and adverse effects and identify alternatives that may mitigate these impacts (CEQ 1997b).

There are 15 municipalities located in and around the park. These municipalities, located in two counties, demonstrate relatively low percentages of those who identify themselves as being of a minority race and/or living below the poverty line (U.S. Census Bureau 2008). Only one municipality, which has less than 1 percent of its land area in the park, has both minority and low-income populations greater than the average of the county in which it is located. The relatively low and dispersed presence of minority and/or

low-income populations in and around the park, combined with the inability to predict where property damage may occur, indicates that both minority/low-income residents and nonminority/non-low-income residents would experience the effects of actions under this plan. Therefore, disproportionately high and adverse effects are not anticipated to be borne by minority and/or low-income populations in and around the park. Also, any donation of deer meat to local charitable organizations would indirectly provide a benefit to low-income populations, although the impact would be relatively negligible. For these reasons, this topic was dismissed from further analysis.

Federally Listed Species

There are two federally protected animal species that are known to occur in the park, and one federally listed plant that is known to occur in Summit County. However, none of these would be affected by deer or deer management actions to more than a negligible to minor degree, as described below for each species.

Indiana Bat

The Indiana bat (*Myotis sodalis*), a federally listed endangered species, is found in the park between April and September (NPS 2011). Impacts from deer management activities may include disturbance, noise, and increased human presence from the implementation of reproductive or lethal control methods or the construction of exclosures. However, these activities would have no impact to minor short-term localized adverse impacts on this species, because it is only active at night and hibernates during winter months, when most of these activities would occur. Seasonal and/or time restrictions on these activities would eliminate or minimize any adverse impacts.

Indiana bats roost beneath peeling or sloughing bark on dead or mature trees, and deer overbrowsing on young saplings may reduce future available roost trees for the bats. Alternatives A and B would have negligible long-term adverse impacts, due to continued deer browsing and reduced forest regeneration. A reduction in browsing pressure, as proposed by deer population control measures in Alternatives C and D, would perpetuate future summer roosting habitat for Indiana bats by allowing forests to regenerate, with long-term beneficial effects.

Because possible adverse impacts on Indiana bats would be negligible to minor, this issue was dismissed from further analysis.

Bald Eagle

Bald eagles are no longer considered an endangered species but are still protected by federal law under the 1940 Bald and Golden Eagle Protection Act. Bald eagles generally nest within 2 miles of open water bodies, preferring habitat that includes large trees or snags for perching and nesting. A nest that has successfully fledged eaglets in 2007, 2008, and 2010 is located within the park. Most of the actions under consideration (sharpshooting, reproductive control) would occur in late fall and winter, which could overlap slightly with the beginning of the eagle nesting season that can start as early as January (Plona, pers. comm., 2011). However, if eagles continue to nest within the park, deer management activities would not occur within 600 feet of any nest, and bait piles/trapping activities can be located to avoid known nesting areas. Under Alternatives A and B, continued deer overbrowsing may adversely affect the habitat of the bald eagle by inhibiting regeneration of mature trees. However, these adverse impacts would be long term and negligible. Therefore, this issue was dismissed from further analysis.

Northern Monkshood

Northern monkshood (*Aconitum noveboracense*) is a federally threatened plant species known to occur in Summit County (USFWS 2011). This plant grows on cool, moist talus slopes of shaded cliff faces in wooded ravines (USFWS 2011), but is not known to occur in the park (NPS 2009h). Because this plant does not exist in the park, and because talus slopes would not likely be prime locations for exclosure construction or deer removal actions, there would be no impact on northern monkshood from proposed deer management alternatives.

Fish and Other Aquatic Species

There are approximately 64 species of fish known to occur within the park (Plona, pers. comm., 2011). Steelhead trout (*Oncorhynchus mykiss*) and bullhead (*Ameiurus melas*) are common in the Cuyahoga River. Bluegill (*Lepomis macrochirus*, *Ictalurus* spp.), bass (*Ambloplites rupestris*, *Micropterus dolomieu*, *M. salmoides*, *Morone chrysops*), and crappie (*Pomoxis* spp.) are common in the park's various lakes and ponds (NPS 2009i, 2010c). Under Alternatives A and B, continued deer overbrowsing could adversely affect the habitat for aquatic species by increasing erosion and soil runoff; however, these impacts are expected to be negligible to minor, adverse, and localized. Similarly, management activities under all alternatives could result in increased erosion and soil runoff through construction of fencing or trampling, which could lead to short-term negligible to minor adverse impacts on aquatic habitat if water bodies are nearby. Alternatives C and D would likely reduce the potential for soil erosion and sedimentation of aquatic habitat due to reduced vegetation loss over many years, resulting in long-term beneficial impacts on fish and other aquatic species. Because adverse impacts on fish and other aquatic species would be negligible or minor, the topic of fish and other aquatic species was dismissed from further analysis.

Soils

Continued overbrowsing by deer would result in a loss of vegetation cover, possibly leading to increased soil erosion and runoff. Reducing deer population numbers through the implementation of Alternatives C and D, resulting in an increase in vegetation cover, may decrease soil erosion and runoff, a beneficial impact. Alternatives A and B would have negligible or minor adverse impacts due to continued deer browsing and loss of vegetation cover, but these impacts would not be at a scale great enough to be measured or evaluated in this plan/EIS. Similarly, implementing the proposed alternatives may increase soil disturbance due to human activities when constructing exclosures or when hunting/tracking deer or conducting deer population surveys. During these activities, soils would primarily be subject to the trampling or shearing forces of human footfalls, but any soil compaction or erosion from these activities would be short term, localized, and negligible, and similar to the effects of routine maintenance actions. Because adverse impacts on soils would be negligible or minor, the topic of soils was dismissed from further analysis.

Water Resources (Quality or Quantity)

Human activities when conducting deer management alternatives may result in increased erosion and soil runoff, leading to short-term minor impacts on water quality. Loss of vegetation cover due to overbrowsing by deer would continue to occur under Alternatives A and B, which could result in increased soil runoff and in negligible to minor adverse impacts on localized water quality. Lethal and reproductive control of deer population numbers, as proposed in Alternatives C and D, would reduce vegetation loss, thus reducing the potential for soil erosion and sedimentation of park streams, resulting in long-term beneficial impacts on water quality. None of the alternatives would affect water quantity or

groundwater. Because adverse impacts on water resources would be negligible or minor, the topic of water resources was dismissed from further analysis.

Land Use/Park Neighbors

Actions taken under this plan have the potential to affect adjacent park neighbors, including farmers and orchard growers, residence owners, or local metroparks. However, impacts on park neighbors were determined to be primarily financial and related to potential loss of landscaping or crops, and there would be no impacts on land use itself and minimal noise effects (see discussion of Soundscapes dismissal). Therefore, impacts related to economic effects on park neighbors are discussed in this plan under the socioeconomic resources discussion, and land use (or a separate topic of park neighbors) was dismissed from further analysis.

Socioeconomic Impacts Related to Tourism

A 2004 study (Fulton et al. 2004) indicates that roughly 66 percent of survey respondents believed that lethal control of deer at the park is acceptable. Of those who believed that lethal deer control at the park was unacceptable, roughly one in three stated that a lethal deer control program at the park would prevent them from visiting the park in the future. Consequently, deer management activities have the potential to affect tourism around the park. However, any impacts on tourism are not expected to be more than negligible to minor, given the large numbers of tourists that visit the park for a wide variety of reasons. Therefore, this topic was dismissed from further analysis.

Effects of Disease Transmission from Deer to Livestock

It has been suggested that an increase in the park deer population could raise the potential risk for increased infectious disease transmission back and forth between livestock and wildlife and result in economic impacts to neighboring farmers. However, there are no known wildlife pathogens that pose a threat to the economic value of domestic livestock in the region (Powers, pers. comm., 2011). While the risk of disease spill-over and spill-back between domestic animal and wildlife populations is always possible, the risk to the local farming community is minimal, and this topic was dismissed from detailed analysis.

Greenhouse Gas Emissions and Climate Change

There is strong evidence linking global climate change to human activities, especially greenhouse gas emissions associated with the burning of fossil fuels (Intergovernmental Panel on Climate Change 2007). Some of the activities associated with deer management, such as the use of vehicles to assist in carrying out management activities, may result in fossil fuel consumption. However, greenhouse gas emissions associated with the plan would be negligible in comparison to park-related, local, and regional greenhouse gas emissions. Furthermore, implementation of any action alternative that preserves the ability of the forest to replace itself by maintaining its regeneration phase sustains the value that forest has in storing greenhouse gases. Therefore, the issue of the contribution of deer management activities to climate change through greenhouse gas emissions was dismissed from further analysis. As for the impact of climate change on park resources that could be impacted by the project, these potential changes are discussed in “Section 3.2, Vegetation.”

1.9 RELATED LAWS, POLICIES, PLANS, AND CONSTRAINTS

1.9.1 NATIONAL PARK SERVICE ORGANIC ACT AND GENERAL AUTHORITIES ACT

By enacting the NPS *Organic Act of 1916*, Congress directed the U.S. Department of the Interior and NPS to manage units of the national park system "to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (16 USC 1).

The NPS General Authorities Act of 1970 supplemented the Organic Act, providing (as codified at 16 USC 1a-1):

> Congress declares that the National Park Service, which began with establishment of Yellowstone National Park in 1872, has since grown to include superlative natural, historic, and recreation areas in every major region of the United States, its territories and island possessions; that these areas, though distinct in character, are united through their inter-related purposes and resources into one national park system as cumulative expressions of a single national heritage; that, individually and collectively, these areas derive increased national dignity and recognition of their superb environmental quality through their inclusion jointly with each other in one national park system preserved and managed for the benefit and inspiration of all the people of the United States; and that it is the purpose of this Act to include all such areas in the System and to clarify the authorities applicable to the system.

Congress thus required the entire national park system to be managed as a whole, and not as constituent parts.

The 1978 *Redwood Amendment* reiterates this mandate by stating that the NPS must conduct its actions in a manner that will ensure no "derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress" (16 USC 1 a-1). Congress intended the language of the 1978 *Amendment* to reiterate the provisions of the *Organic Act*, not to create a substantively different management standard. The House Committee report described the 1978 *Amendment* as a "declaration by Congress" that the promotion and regulation of the national park system is to be consistent with the *Organic Act*. The Senate Committee report stated that under the 1978 *Amendment*, "The Secretary has an absolute duty, which is not to be compromised, to fulfill the mandate of the 1916 Organic Act to take whatever actions and seek whatever relief as will safeguard the units of the national park system." Although the *Organic Act* and the 1978 *Amendment* use different wording ("unimpaired" and "derogation") to describe what the NPS must avoid, both acts define a single standard for the management of the national park system—not two different standards. For simplicity, NPS *Management Policies 2006* uses "impairment," not both statutory phrases, to refer to that single standard.

Despite these mandates, the *Organic Act* and its amendments afford the NPS latitude when making resource decisions to allow appropriate visitor use while preserving resources. Because conservation remains predominant, the NPS seeks to avoid or to minimize adverse impacts on park resources and values. The NPS does, however, have discretion to allow negative impacts when necessary (NPS 2006a, Section 1.4.3, 10). Although some actions and activities cause impacts, the NPS cannot allow an adverse impact that impairs resources or values (NPS 2006a, Section 1.4.3, 10). In the administration of authorized uses, park managers have the discretionary authority to allow and manage uses, provided that the uses will not cause impairment or unacceptable impacts. The *Organic Act* and 1978 *Amendment*

prohibit actions that impair park resources unless a law directly and specifically allows for the action (16 USC 1a-1) (NPS *Management Policies 2006*; NPS 2006a, Section 1.4.3.1).

Pursuant to the *NPS Guidance for Non-Impairment Determinations and the NPS NEPA Process* (NPS 2010d), a non-impairment determination for the selected alternative will be appended to the Record of Decision (ROD).

1.9.2 NPS MANAGEMENT POLICIES 2006

Several sections from the NPS *Management Policies 2006* are relevant to deer management in Cuyahoga Valley National Park, as described below (NPS 2006a).

NPS *Management Policies 2006* instruct park units to maintain as parts of the natural ecosystems of parks all native plants and animals. The NPS achieves this maintenance by "preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur" (NPS 2006a, Section 4.4.1).

Furthermore, the NPS "will adopt park resource preservation, development, and use management strategies that are intended to maintain the natural population fluctuations and processes that influence the dynamics of individual plant and animal populations, groups of plant and animal populations, and migratory animal populations in parks" (NPS 2006a, Section 4.4.1.1).

Whenever the NPS identifies a possible need for reducing the size of a park plant or animal population, the decision will be based on scientifically valid resource information that has been obtained through consultation with technical experts, literature review, inventory, monitoring, or research (NPS 2006a, Section 4.4.2.1). The science team, as previously discussed, was assembled to complete this task.

NPS *Management Policies 2006* also states:

> Whenever possible, natural processes will be relied upon to maintain native plant and animal species and influence natural fluctuations in populations of these species. The [NPS] may intervene to manage individuals or populations of native species … when at least one of the following conditions exists:
>
> - Management is necessary
> - ◊ because a population occurs in an unnaturally high or low concentration as a result of human influences (such as loss of seasonal habitat, the extirpation of predators, the creation of highly productive habitat through agriculture or urban landscapes) and it is not possible to mitigate the effects of the human influences
> - ◊ to protect specific cultural resources
> - ◊ to protect rare, threatened, or endangered species (NPS 2006a, sec. 4.4.2)

NPS *Management Policies 2006* states:

> Where visitor use or other human activities cannot be modified or curtailed, the [National Park Service] may directly reduce the animal population by using several animal population management techniques, either separately or together. These techniques include relocation, public hunting on lands outside a park or where legislatively authorized within a park, habitat management, predator restoration, reproductive intervention, and destruction of animals by NPS personnel or their authorized agents.

Where animal populations are reduced, destroyed animals may be left in natural areas of the park to decompose. (NPS 2006a, Section 4.4.2.1)

1.9.3 DIRECTOR'S ORDER 12: CONSERVATION PLANNING, ENVIRONMENTAL IMPACT ANALYSIS, AND DECISION-MAKING AND HANDBOOK

NPS Director's Order 12 (NPS 2011k) and its accompanying handbook (NPS 2005a) lay the groundwork for how the NPS complies with NEPA. Director's Order 12 and the handbook set forth a planning process for incorporating scientific and technical information and establishing a solid administrative record for NPS projects.

NPS Director's Order 12 requires that impacts on park resources be analyzed in terms of their context, duration, and intensity. It is crucial for the public and decision makers to understand the implications of those impacts in the short and long term, cumulatively, and in context, based on an understanding and interpretation by resource professionals and specialists.

1.9.4 NATURAL RESOURCES REFERENCE MANUAL, NPS-77

The Natural Resources Reference Manual 77 (NPS 1991, in transition), which supersedes the 1991 NPS 77: Natural Resource Management Guideline, provides guidance for NPS employees responsible for managing, conserving, and protecting the natural resources in national park system units.

1.9.5 DIRECTOR'S ORDER 28: CULTURAL RESOURCE MANAGEMENT (2002)

This Director's Order (NPS 2002i) sets forth the guidelines for management of cultural resources, including cultural landscapes, archeological resources, historic and prehistoric structures, museum objects, and ethnographic resources. This order calls for the NPS to protect and manage cultural resources in its custody through effective research, planning, and stewardship in accordance with the policies and principals contained in the NPS *Management Policies 2006*.

1.9.6 OTHER FEDERAL LEGISLATION AND COMPLIANCE REQUIREMENTS

In addition to the NPS Organic Act, the NPS is governed by laws and regulations as described below.

National Environmental Policy Act, 1969, as Amended

NEPA is implemented through regulations of the CEQ (40 CFR 1500–1508). The NPS has in turn adopted procedures to comply with NEPA and the CEQ regulations, including the Department of the Interior NEPA Regulations (43 CFR 46), Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision-making (NPS 2011k), and its accompanying handbook (NPS 2005a). Section 102 (2)(C) of NEPA requires that an EIS be prepared for proposed major federal actions that may significantly affect the quality of the human environment.

Endangered Species Act of 1973, as Amended

The purpose of the Endangered Species Act (ESA) is to conserve "the ecosystems upon which endangered and threatened species depend" and to conserve and recover listed species. Species may be listed as either "endangered" (in danger of extinction) or "threatened" (likely to become endangered). All federal agencies are required to protect listed species and to preserve their habitats. The law also requires federal agencies to consult with the U.S. Fish and Wildlife Service (USFWS) to ensure that the actions

they take, including actions chosen under this deer management plan/EIS, will not jeopardize listed species.

National Historic Preservation Act of 1966, as Amended

Section 106 of NHPA requires that federal agencies consider the effects of their undertakings on properties listed or potentially eligible for listing on the National Register of Historic Places (NRHP). All actions affecting the park's cultural resources must comply with this legislation.

Historic Sites, Buildings, and Antiquities Act, 1935

The Historic Sites, Buildings, and Antiquities Act establishes "national policy to preserve for public use historic sites, buildings and objects of national significance." It gives the Secretary of the Interior broad powers to protect these properties, including the authority to establish and acquire nationally significant historic sites.

Federal Noxious Weed Act, 1975

The Federal Noxious Weed Act (7 USC 2801-2814, January 3, 1975, as amended 1988 and 1994) provides for the control and management of nonindigenous weeds that injure or have the potential to injure the interests of agriculture and commerce, wildlife resources, or the public health. Since actions of deer or management actions could affect the distribution of noxious weeds through seed dispersal, this act was considered in the development of this plan.

Code of Federal Regulations, Title 43

Title 43 of the Code of Federal Regulations (CFR), part 24, describes the four major systems of federal lands administered by the Department of the Interior. In addition, Section 24.4(i) instructs all federal agencies of the Department of the Interior to, among other things, "prepare fish and wildlife management plans in cooperation with State fish and wildlife agencies and other Federal (non-Interior) agencies where appropriate." It also directs agencies to "consult with the States and comply with State permit requirements… except in instances where the Secretary of the Interior determines that such compliance would prevent him from carrying out his statutory responsibilities."

Code of Federal Regulations, Title 36

Title 36, Chapter 1 of the CFR provides the regulations "for the proper use, management, government, and protection of persons, property, and natural and cultural resources within areas under the jurisdiction of the National Park Service" (36 CFR 1.1[a]).

Executive Order 11990, Protection of Wetlands

Executive Order 11990 directs the NPS to avoid to the extent possible long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative.

Bald and Golden Eagle Protection Act of 1940

The Bald and Golden Eagle Protection Act provides protection of the bald eagle and the golden eagle by prohibiting, except under certain specified conditions, the taking of, possession of, and commerce in these birds. The 1972 amendments increased penalties for violating provisions of the act (16 USC 668–668d).

Executive Order 13112, Invasive Species

This executive order requires the NPS to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.

Migratory Bird Treaty Act of 1918

The Migratory Bird Treaty Act implements various treaties and conventions between the United States, Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. Included under the activities prohibited, unless permitted by regulations, is the attempt to

> pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird, included in the terms of this Convention … for the protection of migratory birds…or any part, nest, or egg of any such bird (16 USC 703).

Subject to limitations in the act, the Secretary of the Interior may adopt regulations determining the extent to which, if at all, hunting, taking, capturing, killing, possessing, selling, purchasing, shipping, transporting, or exporting any migratory bird, part, nest, or egg will be allowed, taking into account temperature zones, distribution, abundance, economic value, breeding habits, and migratory flight patterns.

Executive Order 13186 defines the responsibilities of federal agencies to protect migratory birds. This executive order directs executive departments and agencies to take certain actions to further implement the act. Each federal agency taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations is directed to develop and implement, within 2 years, a memorandum of understanding (MOU) with the USFWS to promote the conservation of migratory bird populations.

Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds

Executive Order 13186 was established on the premise that migratory birds contribute to biological diversity, bring enjoyment to millions of Americans, and are of great ecological and economic value to this county and to other countries. Under this order, federal agencies taking actions that have, or are likely to have, a measurable negative effect on the migratory bird population are directed to develop and implement a MOU with the USFWS that promotes the conservation of migratory bird populations. This executive order also requires that the environmental analysis of federal actions required by the NPS or other established environmental review processes evaluate the effects of the action and agency plans on migratory birds, with an emphasis on species of concern. A MOU between the USFWS and NPS is currently in place.

Animal Welfare Act, as Amended (7 USC, 2131-2159)

The Animal Welfare Act requires that minimum standards of care and treatment be provided for certain animals bred for commercial sale, used in research, transported commercially, or exhibited to the public. Individuals who operate facilities in these categories must provide their animals with adequate care and treatment in the areas of housing, handling, sanitation, nutrition, water, veterinary care, and protection from extreme weather and temperatures. Although federal requirements establish acceptable standards, they are not ideal. Regulated businesses are encouraged to exceed the specified minimum standards. Deer

management alternatives that include trapping, euthanasia, or administration of reproductive controls could be regulated by this act.

1.10 RELATIONSHIP TO OTHER PLANNING DOCUMENTS FOR CUYAHOGA VALLEY NATIONAL PARK

As previously mentioned, prior national park planning efforts included a *Final Environmental Assessment and Management Plan for White-tailed Deer* completed in October 1997 (NPS 1997a), which was not implemented. Other park plans call for the protection of park resources and values. These planning efforts include those described below.

1.10.1 STATEMENT FOR MANAGEMENT, CUYAHOGA VALLEY NATIONAL RECREATION AREA

The park's 1993 statement for management contains information about the park's purpose and significance, influences on park resources, major issues, and park management objectives. Increasing deer populations are mentioned as a major issue regarding resource protection and preservation. Also mentioned are the control of nonnative plant species, an impending threat to natural resources from gypsy moths, and natural returns of extirpated species such as beavers and coyotes (NPS 1993).

1.10.2 CUYAHOGA VALLEY NATIONAL RECREATION AREA GENERAL MANAGEMENT PLAN

The 1977 GMP was intended to provide direction for park management during the "land acquisition/initial implementation stage." This plan included a statement for management, a natural resources management plan, a cultural resources management plan, a visitor use and interpretation plan, and a general development plan. "Planning for the park is based on the idea of open-space preservation… The overall concept for management and development of Cuyahoga is that of resource preservation for compatible recreational use" (NPS 1977).

1.10.3 STRATEGIC PLAN, CUYAHOGA VALLEY NATIONAL RECREATION AREA, OCTOBER 1, 2001—SEPTEMBER 30, 2005

The park's strategic plan identifies mission goals for 2001–2005, along with long-term goals under each mission goal. One of the park's long-term goals states, "By September 30, 2005, 25 percent of Cuyahoga Valley National Recreation Area populations of plant and animal species of special concern are at scientifically acceptable levels." The explanation accompanying this goal states, "At Cuyahoga Valley National Recreation Area the white-tailed deer population and state-listed threatened or endangered species are of special concern. These species are being monitored to determine if and when active management action may be required" (NPS 2000b).

1.10.4 RELATED LEGISLATION AND POLICIES

As previously described, surrounding entities have implemented deer management controls through direct reduction efforts. Efforts have taken place at Cleveland Metroparks and MPSSC, as well as in the communities of Pepper Pike and Solon. Future implementation of these control efforts has the potential to affect deer management efforts undertaken at the park.

The Cuyahoga County Planning Commission launched the Cuyahoga Valley Initiative to influence development patterns, construction practices, and industrial processes using a sustainable development approach based on the integration of economic, social, and ecological systems. One of the initiative's vision statements for the valley states, "The Cuyahoga River Valley will become a recreation and leisure activity focal point through a series of experiences which embody the Valley's cultural, historical, and ecological significance. By creating a significant tourist attraction rich in natural resources, the destination-center focus for the Valley will spur economic growth for the region." The commission notes that "while the Valley will never revert back to its original natural condition before development took place, it is still possible to support biodiversity, shape the built environment, and reestablish natural systems in such a way that prevents further degradation of the watershed, waterways, and slopes that characterize the Valley and enhances the Valley's ecology" (Cuyahoga County Planning Commission n.d.a).

Chapter 2

Alternatives

CHAPTER 2: ALTERNATIVES

Chapter 2 describes the various actions that could be implemented for current and future management of white-tailed deer in Cuyahoga Valley National Park. NEPA requires federal agencies to explore a range of reasonable alternatives and to analyze what impacts the alternatives could have on the human environment, which the act defines as the natural and physical environment and the relationship of people with that environment. The analysis of impacts is presented in "Chapter 4: Environmental Consequences," and the conclusions are summarized in the summary of environmental consequences table at the end of this chapter.

The alternatives under consideration must include a "no action" alternative, as prescribed by NEPA regulations in 40 CFR 1502.14. The no action alternative in this document is the continuation of the current management. Deer and vegetation monitoring, data management, and research would continue. No new actions would occur to reduce the effects of deer overbrowsing.

No-Action Alternative—The alternative in which baseline conditions and trends are projected into the future without any substantive changes in management.

Three action alternatives were developed by the interdisciplinary planning team, with feedback from the public and the science team (see "Chapter 5: Consultation and Coordination") during the planning process. These alternatives meet, to a large degree, the management objectives for Cuyahoga Valley National Park and the purpose of and need for action as stated in "Chapter 1: Purpose of and Need for Action." Because these action alternatives would meet the park's objectives and would be technically and economically feasible, they are considered reasonable.

2.1 INTRODUCTION AND OVERVIEW OF ALTERNATIVES

This chapter describes the alternatives developed by the interdisciplinary team for this plan/EIS. All alternatives would meet the purpose, need, and objectives of this plan. Input from the science team and the public was considered and used to refine the preliminary alternatives as planning progressed. Before the action alternatives are described in detail, background information that was used for setting a deer density goal is described. In addition, this section describes the action thresholds, which were developed to help determine when actions (or elements of the preferred alternative) need to be implemented. These action thresholds, recommended by the science team, are based on forest regeneration and restoration of native species. This chapter also includes a discussion of how adaptive management could be applied to the alternatives. The remainder of the chapter addresses alternatives that were considered but eliminated from detailed analysis and the identification of the NPS preferred alternative and the environmentally preferable alternative.

The alternatives are summarized below:

Alternative A: No Action—Existing management would continue under Alternative A, including deer and vegetation monitoring, data management, and research. No new actions would occur to reduce the effects of deer overbrowsing.

Alternative B: Combined Nonlethal Actions—Alternative B would include all actions described under Alternative A, but it would incorporate a combination of nonlethal actions. These actions include the construction of large-scale deer exclosures (fencing) for the purposes of forest regeneration. In addition,

nonsurgical reproductive control of does would be used to restrict population growth when this technology meets certain criteria.

Alternative C: Lethal Actions (Sharpshooting and Capture/Euthanasia)—Alternative C would include all actions described under Alternative A, but it would also add lethal deer management actions to reduce the herd size. The additional actions would include direct reduction of the deer herd by sharpshooting with firearms or by implementing capture and euthanasia of individual deer in certain circumstances where sharpshooting would not be appropriate.

Alternative D: Combined Lethal and Nonlethal Actions—Alternative D would also include all actions described under Alternative A, but it would incorporate a combination of lethal and nonlethal actions from Alternatives B and C. These actions would include the reduction of the deer herd through sharpshooting with firearms or capture and euthanasia and nonsurgical reproductive control of does with an acceptable reproductive control agent to maintain the population. Capture and euthanasia would be used in instances where sharpshooting would not be appropriate.

2.2 ALTERNATIVE A: NO ACTION (CONTINUATION OF EXISTING MANAGEMENT)

The no action alternative is required in NEPA analyses to provide a baseline to measure future impacts against what is occurring now, thus allowing the impacts of action alternatives to be compared. Current management actions that would continue to be implemented include deer population monitoring (e.g., spotlight surveys, distance sampling, and fecal pellet counts), vegetation monitoring (e.g., trillium plots, deer exclosures, long-term ecological monitoring plots), and activities to protect restoration plantings (e.g., protective tree tubes). Current monitoring efforts would continue to record forest regeneration and deer population numbers within the park, although specific monitoring actions could be modified or discontinued over time, depending on the results and the need for monitoring. Educational and interpretive activities would continue to be used to inform the public about deer ecology and park resource issues, and cooperation with regional entities and stakeholders would continue. No additional deer management actions would take place under this alternative.

The actions that would continue under Alternative A would also continue under all the action alternatives.

2.2.1 CURRENT ACTIONS

Research, Monitoring, and Data Management

Current monitoring of both vegetation impacts and deer population levels would continue and could be modified as necessary to better understand any correlations between the two or to account for current conditions. Monitoring and data collection activities that would be common to all alternatives could include any or all of the following methods:

- Monitoring deer numbers by parkwide observations, using the distance sampling method to estimate the deer population density annually using an established protocol (Underwood, Verret, and Fischer 1998)
- Using spotlight surveys (conducted as part of distance sampling) to monitor population composition (i.e., age, sex ratios)

- Conducting fecal pellet counts (NPS 2004c) as a secondary measure of relative deer abundance on a 3-year rotation in conjunction with vegetation measurements at long-term ecological monitoring sites
- Monitoring tree seedlings using an existing vegetation monitoring protocol to determine the status of forest regeneration (NPS 1997b, 1999b), and measuring growth of trillium in paired plots to assess effects of deer browsing on herbaceous vegetation
- Conducting surveillance for evidence of deer overbrowsing where deer are found in high densities; this could include the erection of additional deer exclosures as experimental controls
- Monitoring deer health as the population shows signs of disease, or if a disease has been discovered within the region
- Monitoring the costs of the monitoring actions, including staff time, training, administrative, legal, and public communications costs
- Specific deer population and vegetation monitoring methods that would be used under Alternative A, as well as the other alternatives, are described in Appendix B.

Annual monitoring to determine deer browsing impacts on trillium would include 26 paired plots (each plot consisting of one fenced exclosure and one unfenced control area). Plots were established within appropriate habitat where trillium is known to occur and are currently within zones 3, 4, and 5 as shown in Figure 1-2 in “Chapter 1: Purpose of and Need for Action.” In addition, every 3 years, park staff would monitor seedling growth and species dominance using 12 existing field/forest paired plots in bottomland forest and upland forest in all five zones.

Protection of Restoration Plantings

Small areas containing restored tree plantings would be protected from browsing by placing tree tubes around individual plants or small-scale fencing around planted areas. Tubes or fencing would typically be 5 feet tall to allow trees to grow beyond deer browsing height, at which point tubes and fencing would be removed.

Education and Coordination

Communication with other agencies and the public would be a key component of Alternative A, as well as the other alternatives. Such activities would include continuing education and interpretive programs, displaying exhibits at visitor contact facilities, producing brochures and publications, and conducting teacher workshops and education about the negative effects of feeding deer and the reasons for the park’s feeding ban. The park would also use its website to discuss what the park is doing related to deer management. Press releases and other pertinent deer information would be provided to local news sources.

Under the no action alternative, the park would continue to coordinate with other agencies involved in deer or wildlife management (e.g., Cleveland Metroparks, MPSSC, ODNR Division of Wildlife, county and local governments) on the implementation of deer management efforts. This coordination currently includes sharing study results and data on deer densities, as well as results of removal efforts.

Enforcement of the Existing Wildlife Feeding Ban

The NPS would continue to enforce the existing ban on feeding wildlife within a national park, in accordance with regulation 36 CFR 2.2. Feeding deer is the most problematic form of wildlife feeding in the park, particularly in certain areas where it occurs frequently and may have contributed to very high deer abundance, based on park observations (Petit, pers. comm., 2010c). The park currently enforces the regulation by verbally warning individuals found to be feeding wildlife. Repeat offenders may be cited and fined.

2.2.2 IMPLEMENTATION COSTS

The costs associated with Alternative A over the 15-year planning period would primarily be for monitoring, plus limited protection of restoration plantings, as shown in Table 2-1. Costs of education and coordination, and enforcement of the existing wildlife feeding ban, are assumed to be covered in existing labor costs and thus are not included below.

TABLE 2-1: COST ESTIMATE—ALTERNATIVE A: NO ACTION

Action	Assumptions	Annual Cost ($)	Cost for the 15-Year Planning Period ($)
Research, Monitoring, and Data Management			
Distance sampling/ spotlight surveys	4 staff (GS 11 at approx. $32/hr) for 5 hours per night; 5 nights of survey = $3,200; plus data analysis (20 hours at $32/hr = $640)	3,840	57,600
Vegetation monitoring of existing plots	Data collection and analysis; 90 days each year of seasonal staff (GS 5 at approx. $18/hr) for data collection and input = $12,960, plus 25 days each year of GS 11 staff biologist /botanist for data collection and analysis at $32/hr = $6,400	19,360	290,400
Maintenance of existing monitoring plots	1–2 visits per year per exclosure; minimal materials cost (assume 16 hours at $32/hr = $512)	512	7,680
Protection of Restoration Plantings			
Labor, materials, and staffing costs	Installation of protective tree tubes: 5 acres per year; 500 trees per acre; $10 per tree = $25,000; plus 5 staff hours for each of 2 staff (GS 11 at $32/hr and GS 7 at $22/hr), per acre, plus volunteers = $1,350	26,350	395,250
		TOTAL	**750,930**

2.3 DEER DENSITY GOAL AND THRESHOLD FOR TAKING ACTION UNDER ALTERNATIVES B, C, AND D

The action alternatives (B, C, and D), described later in this chapter, contain actions to support forest regeneration and to protect, conserve, and restore native species and rural landscapes. Before an action alternative can be implemented, the park must first determine (1) where an action needs to be implemented, (2) when the action needs to be taken (i.e., when damage to forest vegetation approaches unacceptable levels), and (3) how many deer would need to be treated (for those alternatives that include reproductive control) or removed (for those alternatives that include deer removal). The following discussion describes the deer management zones established within the park, the threshold for taking action (which is related to vegetation damage from deer browsing), and the deer density goal (which would be used to determine the number of deer that would be treated or removed).

2.3.1 DEER MANAGEMENT ZONES

Deer management actions may be implemented independently within any of the five management zones (see "Figure 1-2: Cuyahoga Valley National Park Deer Management Zones," in "Chapter 1: Purpose of and Need for Action"). The management zones are numbered counter-clockwise starting at the north end of the park. Zone 1 (3,219 acres) covers the northern finger of the park. Zones 2 and 5 are generally located north of I-80, with zone 2 (2,751 acres) to the west of the Cuyahoga River and zone 5 (3,355 acres) to the east. Zones 3 and 4 are south of I-80, with zone 3 (7,258 acres) to the west of the river and zone 4 (9,553 acres) to the east. These zone boundaries were defined along existing divides, such as roads and the river.

2.3.2 THRESHOLD FOR TAKING ACTION

The science team discussed methods of identifying an appropriate threshold for taking action to protect park vegetation, both woody and herbaceous. Because the deer population is to be managed based on the success of forest regeneration, vegetation must be monitored to determine at what point browsing impacts would warrant implementation of the selected management alternative. The point at which action would be needed is called the threshold for taking action, or the action threshold.

To determine the action threshold, the science team considered a number of measurement standards (metrics) for both herbaceous and woody plants within the forest community. The science team then developed a two-level threshold to incorporate both metrics. The first threshold is a level of concern, defined as when 25 percent or more of the plots monitored for either the herbaceous plant or the woody plant metric indicate that regeneration is insufficient. See Appendix B for more detail on the data to be collected for each plant community. The second threshold is a level of action, defined as when 50 percent or more of the plots monitored for **either** metric indicate insufficient regeneration, or when at least 25 percent of the monitored plots for **both** metrics (herbaceous plants and woody plants) indicate insufficient regeneration. The following provides information about the metrics that were selected to assess the status of both herbaceous and woody vegetation and how the monitoring results would be used to determine if action is taken to reduce deer impacts.

Herbaceous Plant Metric: Mean Stem Height of Mature Trillium Plants

This metric is designed to measure the success of forest regeneration by monitoring the growth and reproduction of herbaceous understory vegetation. Per science team recommendations, trillium, a perennial that occurs in the understory of deciduous woodlands throughout the Great Lakes region, was selected as the species to be used as the indicator of deer browsing impacts for this metric, because it is

both a preferred browsing species and a species that needs to reach stem heights of 5 to 5.5 inches for successful reproduction (Anderson 1994). Repeated browsing of plants results in progressively smaller individuals. Because plants must attain a minimum size to reproduce (Hanzawa and Kalisz 1993; Anderson 1994), and because deer preferentially browse on larger and flowering plants (Anderson 1994), the number of plants in flower also decreases with increasing browsing intensity.

Staff at Cuyahoga Valley National Park began annual monitoring to determine deer browsing impacts on trillium in 1996. Twenty-six paired plots, each measuring 11 square feet (1 square meter), were delineated in the study areas; each plot consisted of one fenced exclosure and one unfenced control area. Plots were established within appropriate habitat where trillium was known to occur. As detailed in "Section 3.2, Vegetation," trillium monitoring data collected between 1996 and 2007 consistently showed taller stems in exclosures than in unfenced control areas and a consistently higher number of flowers in exclosures as compared to control areas. Trillium plants inside exclosures were able to reach a stem height that allowed plants to flower. The results of this monitoring indicate that deer browsing has a negative impact on trillium by reducing stem height and consequently preventing reproduction. The monitoring protocol to be used for determining when to take action is included in Appendix B.

The park currently has 26 trillium monitoring plots (paired), as previously described—7 plots within zone 3, 13 in zone 4, and 6 in zone 5. Because there are no trillium monitoring plots in zones 1 and 2, for this metric to be used as an action threshold in all management zones, the park would need to add 4 to 6 trillium monitoring plots to both zones 1 and 2 (8 to 12 additional plots in total, each 1 square meter (about 11 square feet) in size). Figure 2-1 depicts the decision tree used to determine the management level reached based on trillium (herbaceous) monitoring results.

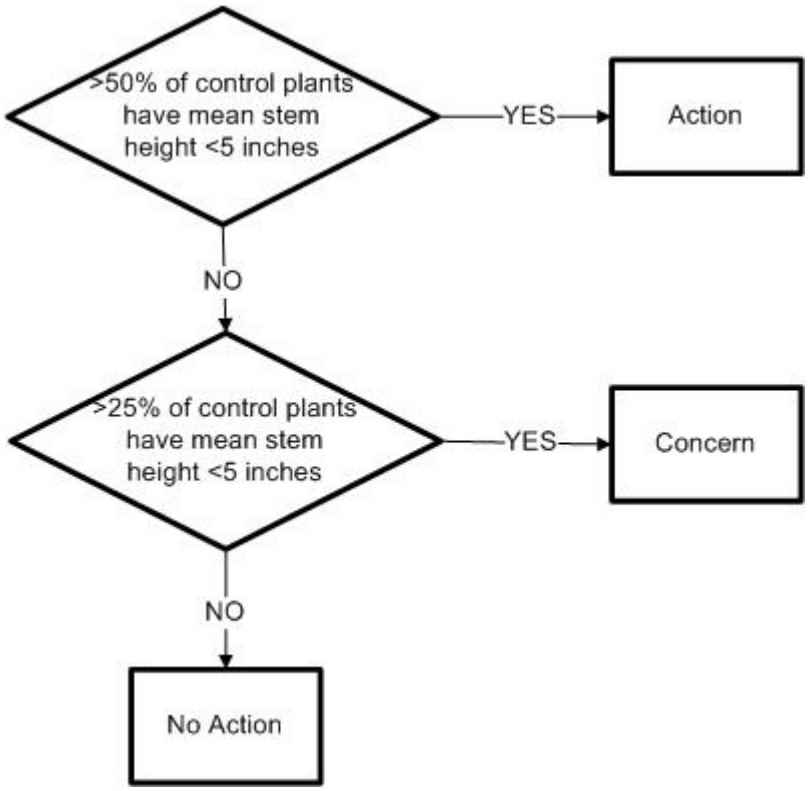


FIGURE 2-1: TRILLIUM (HERBACEOUS) METRICS / MANAGEMENT LEVELS

Woody Plant Metric: Change in Growth of Tallest Seedling

The park selected this metric to measure the success of forest regeneration by monitoring the change in growth of selected tree seedlings. Seedling growth is measured by the change in the height of the tallest seedling in each plot from one sampling period to the next (NPS 2002b. Little growth or zero growth indicates the need to take action to reduce deer browse. Seedling growth would be monitored with paired plots in each zone. This metric would use 12 existing paired plots (fenced/unfenced) in bottomland and upland, which are monitored every 3 years. (Existing plots are located as follows: 1 plot in zone 1, 2 in zone 2, 4 in zone 3, 2 in zone 4, 3 in zone 5). This metric would require the park to add 13 additional plots (10 × 10 meter (about 33 feet) exclosures), resulting in a total of 5 plots per zone. The monitoring protocol to be used for determining when to take action is included in Appendix B. Figure 2-2 depicts the decision tree used to determine the management level reached based on woody seedling growth monitoring results.

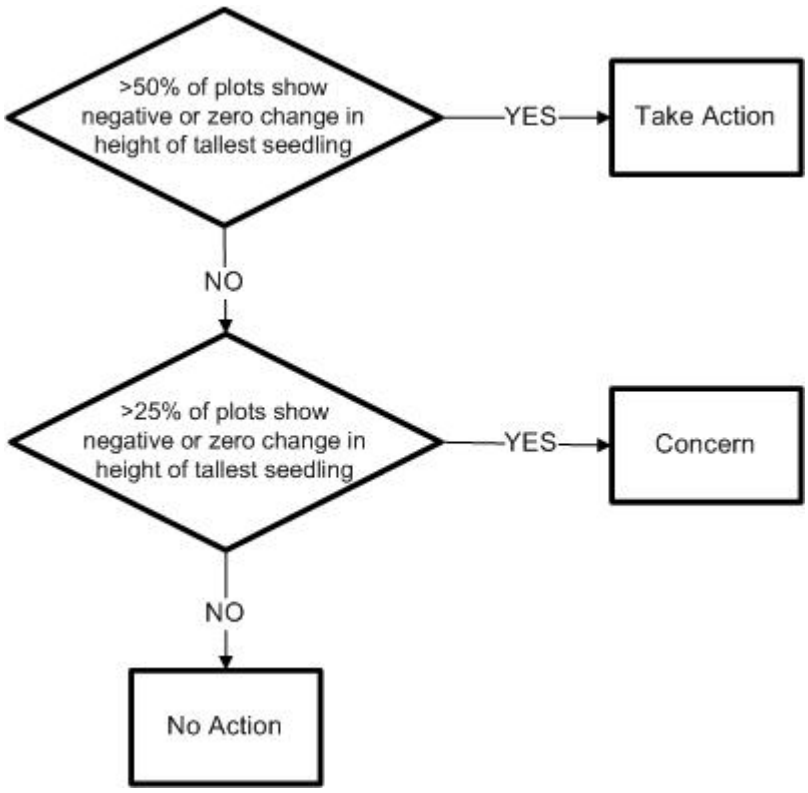


FIGURE 2-2: WOODY PLANT METRICS / MANAGEMENT LEVELS

Matrix to Determine Action

The park would implement the deer management plan at the management zone scale; therefore, the park would evaluate whether action needed to be taken in each management zone by determining the management levels (i.e., concern, action, none) for both the herbaceous and woody plant metrics in each zone. Figure 2-3 illustrates the two-level threshold concept.

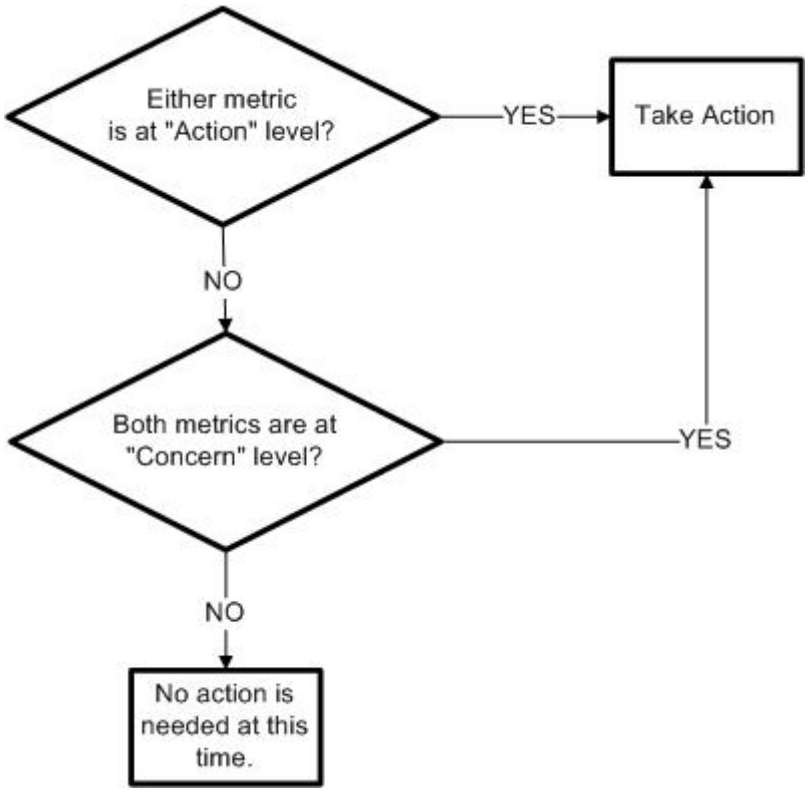


FIGURE 2-3: ACTION LEVEL BASED ON BOTH HERBACEOUS AND WOODY METRICS

Table 2-2 presents a hypothetical situation that demonstrates how the management levels determined through each metric would be combined to determine which zones require management actions.

TABLE 2-2: HYPOTHETICAL DETERMINATION OF ACTION LEVEL (BASED ON BOTH METRICS)

Metrics	Management Level Reached				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Trillium height	None	Concern	None	Concern	Action
Woody plant height	Action	Concern	None	None	Action
Action triggered?	**Yes**	**Yes**	**No**	**No**	**Yes**

2.3.3 INITIAL DEER DENSITY GOAL

The deer density goal for Cuyahoga Valley National Park is defined as the number of deer per square mile that would allow for natural forest regeneration and restoration of native species. This density would then be used as an initial goal under the action alternatives. Distance sampling at the park shows that the deer density in various zones ranged between 21 and 116 deer per square mile from 1998 to 2010. In 2010, the latest year for which data had been analyzed, deer densities in the various zones ranged from 31 to 80 deer per square mile, with a parkwide deer density of about 41 deer per square mile.

Acceptable deer densities, based on a review of pertinent scientific literature by the science team (Tilghman 1989; Marquis, Ernst, and Stout 1992; deCalesta 1992; Horsley, Stout, and deCalesta 2003; and Sage, Porter, and Underwood 2003) and the experience of local wildlife managers, may range from

10 to 40 deer per square mile, depending on the specific goals of the area to be managed. Based on recent research, a density of 13 deer per square mile is recommended for regeneration within a maple/beech/ birch forest (Sage, Porter, and Underwood 2003); negative impacts of deer browsing start to appear at 20 deer per square mile (Horsley, Stout, and deCalesta 2003). Additionally, Stout (1999) suggests that a low deer density of 13 to 21 deer per square mile allows for forest regeneration in Pennsylvania forests.

A number of researchers have estimated a maximum deer density for the successful reproduction of various species such as trillium (Anderson 1994; Augustine and Frelich 1998), hardwood seedlings (Drake and Palmer 1991), and intermediate canopy-nesting songbirds (deCalesta 1994). Anderson (1994) documented that to maintain reproductive trillium populations in northeastern Illinois deciduous forests, deer density should be less than or equal to 10 to 16 deer per square mile. Augustine and Frelich (1998) found that deer in deciduous forest habitat focus their grazing on large, reproductive trillium plants, skewing the trillium population structure toward small plants. Additionally, where deer densities were greater than 10 to 20 deer per square mile, deer consistently caused over a 50 percent reduction in trillium reproduction during the growing season. Their research also indicated that individual plants need protection from deer browsing for at least two growing seasons to show a dramatic increase in flowering rates and leaf area after experiencing high deer densities (greater than 10 to 20 deer per square mile). DeCalesta (1994) found substantial negative effects on songbird populations, specifically ground-nesting birds, with deer densities greater than 20 deer per square mile.

The science team also considered management approaches used in other local parks and by the state of Ohio. Cleveland Metroparks, which shares common boundaries with Cuyahoga Valley National Park, generally has a goal of 15 to 30 deer per square mile (Cleveland Metroparks 2006a), whereas MPSSC has a goal of less than 20 deer per square mile (Johnson, pers. comm., 2010; MPSSC 2010b), and the ODNR manages for a prehunt population density of 30 deer per square mile (NPS 2007a). Each of these agencies noted that it does not manage specifically to a deer density goal, but uses deer density as a gauge along with other vegetation monitoring to determine whether management actions are needed (NPS 2007a).

Based on the NPS goal of protecting and promoting forest regeneration and native plant diversity within the park, the science team recommended that the maximum density in the park should not exceed 30 deer per square mile. Based on the collective experience of the science team, vegetation in various study areas (e.g., New York, Pennsylvania, Ohio) has not rebounded with deer densities greater than 30 deer per square mile. With high deer densities, annual population increases can be large, resulting in fluctuations of well over 30 deer per square mile in just 1 to 2 years.

Based on the science team's recommendation, the park selected a range of 15 to 30 deer per square mile as the initial deer density goal. The team suggested that a range would be appropriate for the initial goal, given the variability of current deer densities within the different management zones in the park. The range suggested is supported by recent findings and research for regeneration in forest types similar to those in Cuyahoga Valley National Park. This goal may be adjusted based on the results of vegetation and deer population monitoring, as described in "Section 2.8, Adaptive Management Approaches Included in the Alternatives."

Based on the science team's recommendation and recent research, a range of 15 to 30 deer per square mile as the initial deer density goal allows for forest regeneration.

2.4 ELEMENTS COMMON TO ALL ACTION ALTERNATIVES (ALTERNATIVES B, C, AND D)

The following elements (as described in "Section 2.2, Alternative A: No Action (Continuation of Existing Management)") would also be included in all action alternatives:

- Research, monitoring, and data management
- Protection of restoration plantings
- Education and coordination
- Enforcement of the existing wildlife feeding ban.

Additional actions that would be included under all action alternatives are described in the sections below. These actions include the use of authorized agents and skilled volunteers acting under direct NPS supervision to assist in performing various management actions.

2.4.1 USE OF AUTHORIZED AGENTS AND SKILLED VOLUNTEERS

Under each of the action alternatives, the NPS would solicit the help of authorized agents to assist in management actions. Authorized agents include, but are not limited to, other agency and tribal personnel and contractors. Skilled volunteers may be used for certain functions.

For the purposes of this plan, a contractor would be a fully insured business entity, nonprofit group, or other entity engaged in wildlife management activities that include direct reduction with firearms and/or remote application of reproductive control agents. The contractor would possess all necessary permits to conduct work, depending on the management activity. Compliance with all relevant NPS directives related to firearm use in parks, as well as federal firearm laws administered by the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) would be required. The park would develop specific guidelines for firearm use.

The use of skilled volunteers may be considered by the park depending on the activity being implemented. For the purposes of this plan/EIS, volunteers would not be used to administer reproductive controls or lethal reduction (involving the use of chemicals or firearms). Safety concerns related to high visitation, park boundaries, and topography make the use of volunteers for these activities an infeasible option. However, skilled volunteers could be used to assist in the implementation of other elements included in the action alternatives. Volunteers could assist park staff with construction of fencing and deer exclosures, as well as performing periodic monitoring and maintenance of fencing. Volunteers could also be used to collect data from vegetation monitoring plots and nighttime spotlight counts.

2.4.2 CHRONIC WASTING DISEASE SURVEILLANCE AND TESTING

CWD is in the family of diseases known as the transmissible spongiform encephalopathies (TSEs), or prion diseases. Other TSEs include scrapie in sheep, bovine spongiform encephalopathy (BSE, or mad cow disease), and Creutzfeldt-Jakob disease (CJD) in humans. CWD causes brain lesions in affected deer and elk that result in progressive weight loss, behavioral changes, and eventually death. There is currently no evidence that the disease is transmissible to humans or domestic livestock; however, the disease could affect populations of deer and elk and can impact the recreational value of these species.

The NPS has summarized some of the most pertinent CWD literature, management options, and policies as they pertain to units of the national park system in its *A National Park Service Manager's Reference*

Notebook to Understanding Chronic Wasting Disease (CWD Reference Notebook) (NPS 2007b). The reference notebook has identified two levels of action based on risk of transmission (also see Appendix C for further CWD information). The higher level of surveillance is triggered when the disease is known to occur within the park or within a 60-mile radius. As of January 2011, the nearest known confirmed CWD case in free-ranging deer was in West Virginia, about 200 miles from the park (Powers, pers. comm., 2010; Petit, pers. comm., 2011c). Given existing NPS guidance and the fact that the nearest known CWD case is more than 60 miles from the park, park staff would initiate the following actions.

CWD Surveillance— Opportunistic surveillance involves taking diagnostic samples for CWD testing from deer found dead or harvested within a national park system unit.

Targeted surveillance involves lethal removal and testing of any deer exhibiting clinical signs consistent with CWD.

Under all action alternatives, park staff would initiate opportunistic surveillance on available deer carcasses as appropriate and as needed. Opportunistic surveillance involves taking diagnostic samples for CWD testing from deer found dead or harvested within a national park system unit. Cause of death may be hunting, culling, predators, disease, trauma (e.g., from deer/vehicle collision), or undetermined. Opportunistic surveillance would have little, if any, negative impact on current populations (NPS 2007b). It is assumed that opportunistic sampling would create a random sample; however, it is acknowledged that this method is likely to be a more sensitive measure of disease recognition (i.e., animals found dead are more likely to be diseased).

If CWD is found within 60 miles of the park, the park would continue opportunistic surveillance and would also perform targeted surveillance as a component of any action alternative, as required by NPS guidance (NPS 2007b). Targeted surveillance involves lethal removal and testing of any deer exhibiting clinical signs consistent with CWD. Targeted surveillance would have negligible negative effects on the current population, would remove a potential source of CWD infection, and would be an efficient means of detecting new foci of infection. Park employees or authorized agents would be trained to recognize and report deer exhibiting clinical symptoms of CWD, to monitor deer exhibiting clinical symptoms, and to implement the targeted surveillance in a manner consistent with NPS guidance.

NPS staff or authorized agents would conduct visual surveys for deer exhibiting clinical signs of CWD during their daily work activities, which often involve travel throughout the park or direct interaction with deer (e.g., deer surveys, deer/vehicle collision response). Under targeted surveillance, NPS staff would remove deer exhibiting clinical signs of CWD under the existing protocol for euthanasia of wildlife using an appropriate firearm.

Park staff would coordinate with the ODNR, other appropriate state wildlife and/or agriculture agencies, and certified laboratories as necessary regarding surveillance methods, sample sizes, testing, and results. Should targeted surveillance be initiated, the park would increase coordination with state agencies and would pool samples to ensure adequate sample size to evaluate disease prevalence and to monitor and evaluate changes in CWD risk to the park. The park would pursue whether test results could be combined with the state's larger sample until a statistically valid sample size has been reached to ensure reasonable certainty that CWD is not present within the park's deer population. The time necessary to reach a statistically valid sample size would vary depending on the opportunities available annually and on the population size. If there were positive test results from deer in the park, the park would coordinate with the state in designating a disease control unit to collect deer for further testing. A disease control unit, as defined by *Ohio's Chronic Wasting Disease Surveillance and Response Plan* (ODA CWD Plan) (ODA 2006), is an area 6 miles in radius established to identify a location of gathering samples for additional surveillance by culling deer. If there were no positive results, the park would continue to conduct opportunistic and/or targeted surveillance depending on the proximity of the nearest positive case.

2.4.3 DONATION FOR CONSUMPTION OR DISPOSAL OF CARCASSES

The NPS would donate deer meat (e.g., to local charitable organizations, nonprofit food banks) to the maximum extent possible, as permitted by regulations and NPS guidelines (NPS 2007b). If donation were not possible, then carcasses would be disposed of. Further details on donation and disposal are described below and are included under each alternative in relation to the types of management actions included.

Donation for Consumption

Donating deer meat would depend on the suitability of meat for donation, which would be based on, but not limited to, the following factors:

- Public health and veterinary guidance (e.g., whether chemicals were used for euthanasia)
- Amount of waste or carcasses and capacity of processors to render meat suitable for donation
- Distance from trails, roads, and facilities
- Proximity of CWD to the park
- Willingness of available entities to accept donated meat.

If meat is suitable for donation, field dressing would occur in the park, and the entrails (internal parts) would be buried if there is an appropriate location and based on the proximity of the nearest CWD case. Otherwise, entrails would be placed in barrels for disposal at a processing facility or other appropriate facility. Carcasses would be stored until any needed CWD testing results are obtained and then transported to a butcher (potentially, several meat-processing facilities would be needed, depending on capacity) for processing. Processed meat would be provided directly from the meat-processing facility to a third-party entity (e.g., a local charitable food bank or food pantry) for the purpose of redistribution for consumption.

In donating meat, the park would follow guidance from the NPS Office of Public Health and the Biological Resource Management Division (BRMD) with regard to CWD, in addition to state and local requirements. Per NPS Office of Public Health guidelines, CWD testing would occur to the maximum extent practicable before any carcasses are considered for donation. Deer would only be donated for consumption if they are confirmed CWD-negative deer or if the required detection confidence level indicates that CWD is not likely within the population. Should future testing detect a confirmed CWD case within 60 miles of the park, other NPS Office of Public Health guidelines would be applied and the park would consult with both the NPS Office of Public Health and the BRMD regarding CWD testing and meat donation (NPS 2007b).

Surface Disposal of Deer

In cases where one to a few deer have been killed at a given site (e.g., by vehicle collision or predation) and when CWD is not known to exist within 60 miles of the park, the waste or carcasses could be moved away from roads and trails and then scattered and left on the surface to be scavenged and/or to decompose naturally. Surface disposal might be acceptable in limited situations where access to the carcass is difficult or not in a highly visible area. In these circumstances, every effort would be made to reduce the visibility of carcasses to visitors or park neighbors.

Disposal of Deer Carcasses Not Suitable for Consumption or Surface Disposal

Deer carcasses and waste not suitable for donation for consumption or for surface disposal would continue to be disposed of at an approved local landfill. The park would investigate appropriate landfills and costs as the need arises. Any landfill selected would meet modern sanitary landfill standards, including engineered liners, caps, and leachate and gas collection systems.

Disposal of CWD-Positive Deer Carcasses

Should a CWD-positive case be identified within the park's deer population, the park would remove deer carcasses from the environment to minimize the potential for carcasses to become a source of environmental contamination. The park would dispose of CWD-positive carcasses and any other deer parts in accordance with the NPS CWD Reference Notebook (NPS 2007b) and the ODA CWD Plan (ODA 2006) and would coordinate with state agencies as appropriate. This would require off-site disposal through alkaline digestion or incineration or disposal at a local licensed municipal solid waste landfill as described above.

2.4.4 CAPTURE, HANDLING, AND CARE OF DEER

NPS staff and authorized agents would follow current guidelines in accordance with American Veterinary Medical Association (AVMA) recommendations for the humane treatment of animals to the greatest extent possible. Every effort would be made to minimize the degree of human contact during procedures that require the handling of deer (AVMA 2001).

2.5 ALTERNATIVE B: COMBINED NONLETHAL ACTIONS

A combination of nonlethal actions would be implemented under Alternative B, in addition to the actions under Alternative A and those common to all action alternatives. To protect forest seedlings and promote forest regeneration, deer exclosures (fencing) would be used along with reproductive control measures to manage deer population growth and to gradually reduce deer numbers in the park. The additional actions would include constructing large-scale fenced exclosures to enable forest regeneration. To restrict population growth and gradually reduce deer numbers, the park would implement nonsurgical reproductive control of does if an appropriate agent meets the criteria listed under this alternative (e.g., federally approved, reasonable expectation of success in a free-ranging population, multiyear efficacy per dose, remote delivery method, and safety of deer meat for consumption). All actions would be carried out by NPS personnel and/or their authorized agents as described in "Section 2.4, Elements Common to All Action Alternatives."

2.5.1 ADDITIONAL PROPOSED ACTIONS UNDER ALTERNATIVE B

When the alternatives were developed, it was determined that landscape modifications or large-scale deer exclosures (to allow forest regeneration or the restoration of native species), as well as reproductive control alone would be insufficient and would not meet plan objectives (see "Section 2.10, Alternatives Considered but Dismissed from Detailed Analysis"). Therefore, Alternative B includes a combination of large-scale exclosures for forest regeneration along with the implementation of reproductive control if an appropriate control agent is available.

Large-scale Exclosures

In addition to the small restoration areas that would be fenced or protected by tree tubes under Alternative A, larger fenced exclosures would be constructed under Alternative B to temporarily remove deer browsing impacts and allow forest regeneration to occur. The science team estimated that approximately 20 percent of the park's forest (approximately 3,000 acres) would need to be fenced to allow for adequate forest regeneration at current deer densities if no other management action were implemented (NPS 2007a). By using other measures to control deer population size, the number of deer exclosures required could be reduced. For the purposes of this document, it is estimated that about 5 percent of the park's forest, or approximately 700 acres, would be within constructed exclosures since nonsurgical reproductive control would also be implemented under this alternative. This figure might need to be increased if it was found that reproductive control was not being effective in reducing the deer population.

To fence those 700 acres, park staff would construct up to 30 large exclosures, each approximately 1,000 feet × 1,000 feet and each covering about 23 acres, although some variation in sizes and numbers could occur in order to fit the exclosures into the landscape and minimize visual intrusion. The exclosures would be scattered throughout the park, with locations selected to focus on those areas needing the most protection and with regeneration potential. When defining exclosure locations and the amount of fencing required, park staff would consider the proposed locations in relation to visitor use areas, park boundaries, accessibility, and maintenance requirements. High-use visitor areas or areas with the potential for adverse visual impacts on park users and park neighbors would be avoided as much as possible.

Fencing for large exclosures would be about 8 feet high and would consist of woven wire with openings that would allow most small animals to move freely through the fence. Metal and wood posts would be used as supports. It is expected that the technical details (e.g., type of footer, post type and spacing) related to fence installation would vary based on factors such as site topography, geologic substrate, access, potential visibility, and presence of archeological resources. Electric fencing would not be used in the park because of concerns for visitor safety, difficulty in accessing a power source, and long-term maintenance requirements.

Deer would be driven out of the exclosures by park staff before completion by having staff line up and walk toward the remaining open side of the exclosure, thereby herding any remaining deer out of the area before the last side is erected. All exclosures would be maintained by park staff. Maintenance would consist of visual inspection for fence integrity at least four times per year and after any major storm event. If any deer were found within an exclosure, they would be driven out of the exclosures by park staff, as would any other animals that appeared to be trapped within the exclosure. Visitors would not be able to use the areas inside exclosures during or after construction.

Based on the experience of science team members and the regrowth noted in park exclosures over the past decade, it is estimated that about 10 years would be required for adequate seedling recruitment and growth in the exclosures to exceed the typical deer browsing height—approximately 60 inches (Petit pers. comm., 2010c). This time frame is supported by data from Horsley, Stout, and deCalesta (2003), as well as Webster, Jenkins, and Rock (2005), which showed that browse-tolerant species had substantial recovery after 8 years, and more browse-sensitive species were not able to recolonize well. Annani, Klips, and Curtis (2006) also found that generalist species could recover in about a 14-year period, so a 10-year time frame appears reasonable. After seedlings exceeded browse height, the exclosures could be moved to immediately adjacent areas in order to reuse one side of the previous exclosure, thus minimizing relocation and labor costs.

It is assumed that most of the woody vegetation regenerated during 10 years in the exclosure areas would persist after the exclosures were removed. However, the herbaceous layer in the original exclosures would

be exposed to deer browsing pressure after the exclosure was removed. Therefore, for purposes of the impact analysis (see "Chapter 4: Environmental Consequences"), it is assumed that the exclosures in Alternative B would achieve the objective of woody regeneration in 5 to 10 percent of the park over the life of the plan (15 years), and that the objective of herbaceous regeneration would be met within a maximum of 5 percent of the park at any one time over the life of the plan.

Nonsurgical Reproductive Control of Does

Several reproductive control agents are currently being developed and tested for use in deer population control (Fraker et al. 2002). These agents are described briefly in Table 2-3 and in more detail in Appendix D, which provides an overview of reproductive control technologies for deer management. Particular product names are included in this plan for analysis purposes only. The NPS is not limited to using the particular products listed or analyzed in this plan and would evaluate products based on criteria (as described below) to determine whether a suitable agent exists for park implementation.

TABLE 2-3: REPRODUCTIVE CONTROL AGENTS

Issue	Standard (Native) PZP Vaccine	SpayVac™ (PZP vaccine)	GonaCon™ (GnRH Vaccine)	Leuprolide (GnRH agonist)	Prostaglandin $F_{2\alpha}$ (contragestive)
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	Pre-term pregnancy termination
How administered	Injection	Injection	Injection	Injection	Injection
Number of doses	Twice initially and an annual booster	Once initially and booster every 3–5 years	A single injection initially; if and when antibodies decline, retreatment would be required	Current formulation —annually	Single injection per pregnancy
Timing	Treat before breeding season and allow suffi-cient time for antibody development	Treat before breeding season and allow suffi-cient time for anti-body development	Treat before breeding season and allow sufficient time for antibody development	Treat immediately before breeding season on an annual basis	Treat when animal is pregnant

Alternative B would include treating female deer with a chemical reproductive control agent to reduce population growth. The current status of research related to nonsurgical reproductive control technologies provides results that are highly variable related to key elements such as efficacy and duration of contraceptive effect. There are also logistical issues related to the administration of these drugs that could affect success of implementation and sustainability of a reproductive control program at the parks. Therefore, only when the criteria listed in Table 2-4 are met would reproductive control be implemented as a management technique.

Immunocontraceptive—A reproductive control agent that causes an animal to produce antibodies against some protein or peptide involved in reproduction. The antibodies hinder or prevent some aspect of the reproductive process.

No reproductive control agents are currently available that meet these criteria (see Table 2-5). Currently, the agent that comes closest to meeting all the criteria is GonaCon ™, which was approved and registered by the EPA in 2009 for use as a contraceptive for controlling white-tailed deer populations (EPA 2009). However, it is possible that an agent that meets all the criteria could be developed during the lifetime of this plan, and therefore, this option has been considered for detailed analysis. For the purposes of this discussion and environmental impact analysis, it is assumed that a reproductive control agent that meets these criteria would be available, and GonaCon™ is used as an example only. The use of any reproductive control agents for population management would require approval from the EPA.

The approved method of application for GonaCon™ is an injection into a large muscle mass by hand injection only, meaning that the use of this or any other similar agent would require capture and handling of deer; this would be true initially for any agent used, since it would be necessary to mark the deer the first time they are captured. For GonaCon™, the registration states that female deer are to be injected with a single injection at least 2 to 3 months prior to the onset of rut for full contraceptive effect, although timing of reproductive control administration will vary with the agent used. There is no requirement prohibiting human consumption, which meets one of the NPS criteria for use.

TABLE 2-4: REPRODUCTIVE CONTROL AGENT CRITERIA

Reproductive Control Agent Criteria	Rationale for Criteria
1. There is a federally approved fertility control agent for application to free-ranging populations.	It is critical that all aspects of a fertility control program be consistent with federal laws and regulations and NPS policies.
2. The agent provides multiyear (3–5 years) efficacy.	Modeling efforts have clearly demonstrated that (1) “the efficacy of fertility control as a management technique depends strongly on the [multiyear] persistence of … the fertility control agent” and (2) the only scenarios in which fertility control is more efficient than culling at maintaining population size is when a multiyear efficacy is achieved (Hobbs, Bowden, and Baker 2000).
3. The agent can be administered through remote injection.	Remote delivery reduces the frequency of stressful capture and/or drug delivery operations.
4. The agent would leave no hormonal residue in the meat (i.e., meat derived from treated animals should be safe for human consumption according to applicable regulatory agencies).	Any fertility control agent applied in free-ranging wildlife populations that are contiguous with areas or with the same species that are hunted must be safe for human consumption.
5. Overall, there is substantial proof of success with limited behavioral impacts in a free-ranging population, based on scientific review and NPS policy.	No study has demonstrated that fertility control works to reduce deer numbers in free-ranging populations to the extent needed at the park to allow for tree regeneration, so it is important that proof of success be demonstrated. Also, it is important that any agent used meet NPS policies, including those regarding altered behavior (NPS 2006a, Section 4.4.1).

TABLE 2-5: EVALUATION OF FERTILITY CONTROL AGENTS BASED ON SELECTION CRITERIA

Agent	Criterion 1 Federally Approved	Criterion 2 Multiyear Efficacy (3+)	Criterion 3 Capable of Remote Administration	Criterion 4 Meat Safe for Humans	Criterion 5 Success in Free-ranging Populations
Immunocontraceptives					
"Native" PZP	No	No [a]	Yes	Likely, but need EPA approval	Yes, but only in closed populations or on a very small scale
SpayVac™	No	Possibly [b]	Unknown		
GnRH (GonaCon™)	Yes	Possibly [c]	Possibly [d]	Yes	Untested
GnRH Agonists					
Leuprolide acetate	No	No	Yes	Likely, but need EPA approval	Untested
Histrelin acetate	No	No	No	Likely, but need EPA approval	Untested
Other					
GnRH toxins	No	Unknown	Unknown	Likely but unknown	Untested
Steroid hormones	No	No	Unknown	Unlikely, but need regulatory guidance	Untested
Contragestives	No	No	Yes	Yes	Not likely but untested

[a] Initial research on one-shot, multiyear PZP vaccine has demonstrated 88.3% efficacy in year 1 and 75% efficacy in the second year after treatment (Turner et al. 2008). Research is currently ongoing to evaluate effectiveness in year 3 and beyond. Rutberg has indicated that "based on the design of the vaccine and our experience with horses, it's unlikely that the vaccine would have much effect past the third year" (Rutberg, pers. comm., 2009). However, research on this vaccine is still developing and is expected to continue into the future.

[b] SpayVac™ has demonstrated 80%–100% efficacy for up to 5–7 years in horses and deer (Fraker, pers. comm., 2009; Miller, Fagertone, et al. 2009; Killian et al. 2008). The term "possibly" is used because long-term studies (>5 years) have been conducted only in captive deer and had a small sample size in each treatment group (N = 5) (Miller, Fagertone, et al. 2009).

[c] Recently published 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 after treatment (Miller, Gionfriddo, et al. 2008). The term "possibly" is used because the multi-year formulation has been used only in captive deer, had a small sample size, and lacks confidence intervals on the data.

[d] Recent work published used dart delivery to administer the GnRH vaccine to elk (Killian et al. 2009).

The park would monitor the status of ongoing reproductive control research on a periodic basis through consultation with subject matter experts and review of new publications. When there are advances in technology that could benefit deer management in the park, the choice of an appropriate agent would be determined based on how well the criteria were met, availability, cost, efficacy, duration, safety, and feasibility. See Appendix D for an overview of reproductive control agents and methods.

Administration of Reproductive Control

Timing of Application—Administration of any reproductive control agent would most likely be done during the months of late October through March, because this is when the deer are easier to capture, when the least number of visitors would be in the park, and when there would be less stress on the deer.

Summer months would be avoided because of potential heat stress on the deer. For the purposes of this example analysis, it is conservatively assumed that GonaCon™ or a similar agent would need to be reapplied every 2 years, although it is recognized that its efficacy may vary and this frequency could be adjusted. If long-term studies show that efficacy is prolonged with repeated vaccinations, reapplication may be less intensive. Any agent selected would meet the criterion that required multi-year efficacy, preferably lasting 3 to 5 years.

Number of Does Treated—To effectively reduce population size, treatment with a reproductive control agent must decrease the reproductive rate to less than the mortality rate, which is approximately 10 percent in urban deer populations. Based on research of reproductive control in a free-ranging deer population, it would be necessary to treat at least 90 percent of the does annually in order to begin to reduce 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 percent) reduction in the population could be expected (Hobbs, Bowden, and Baker 2000).

The park's 2010 deer population was estimated at 1,669 deer, based on the average density of 41 deer per square mile and the area surveyed (about 40.7 square miles). Assuming approximately 50 percent of the deer in the park (834 deer) are does, a minimum of 751 does (90 percent of 834) would need to be treated every 2 years to control population growth. Given the large number of does to be treated and the desire to accomplish this in the 4–5 month period from approximately November to March it is assumed that one-half (375 does) would be treated the first year, and the other 375 does the following year, and then treatments would occur every other year for both groups. This assumes that about 4 does can be treated per day, using two teams of two to three people (an estimate used based on experience with capture and tagging at Valley Forge National Historic Park (NPS 2009j)), and work would occur 5 days a week.

Application Procedures

No matter what type of agent is used, does would need to be captured initially for marking to avoid multiple treatments of the same does in the same year and to facilitate tracking for future applications in subsequent years. Several methods of wildlife trapping could be used, including but not limited to drop nets and box traps. Deer could also be immobilized by darting with a tranquilizer gun (Schwartz et al. 1997). This method could be used in cases where deer had not been successfully attracted to a trap area.

Most trapping methods involve using bait to attract deer to a specific area or trap. Box traps involve a confined space that safely holds the deer so that staff can approach it. Drop net traps also often use bait to attract deer to the drop zone, where suspended nets are triggered to drop over the deer and restrain it for staff to approach (Lopez et al. 1998). The method of capture would be selected based on the specific circumstances (e.g., location, number of deer, accessibility, and reasons why sharpshooting is not advised) for each deer or group to be removed. Given the large number of does that would need to be treated, bait piles would be used to concentrate does in certain locations so that trapping could be done as efficiently as possible. Marking would likely be accomplished using ear tags.

Some capture and handling-related mortality could occur under this method due to tranquilizer use and stress on the doe (DeNicola and Swihart 1997; Kilpatrick, Spohr, and DeNicola 1997); generally, a 2 to 5 percent mortality rate would be expected. Cleveland Metroparks (White Buffalo Inc., 2004) reported that of the 37 does captured and treated with SpayVac™ in 2004, only one doe (2.7 percent) died during capture procedures. This appears to be the only capture-related mortality occurring in 254 doe captures (0.3 percent) over 4 years, using both tranquilizer darting and drop nets.

After the first application, any agent selected for use that meets the criteria established by NPS would be delivered by remote injection. Injection would likely be remotely delivered by dart or biobullet (plastic

bullets impregnated with an immunocontraceptive), using a dart-type gun (similar to a shotgun). With the biobullet method, the biobullet remains with the doe and it is not necessary to recover spent darts. Currently, GonaCon™ is not labeled for this type of delivery.

As many does as possible would be treated daily until 90 percent of the does had been treated. Visitor access would be restricted in certain areas of the park during the treatment period. The areas targeted for treatment would be chosen based on maximizing deer presence and accessibility while minimizing visitor inconvenience.

Qualifications

Regardless of the technique implemented, qualified federal employees or authorized agents meeting EPA registration requirements would perform these activities under the supervision of a qualified veterinarian (if required). Federal employees or authorized agents would also be qualified to handle live does in order to prevent disease transmission or any harm to the animal or the handler.

Monitoring

Vegetation

Open areas (areas not exclosed) would be monitored for changes in vegetation due to a probable increase in browsing. Forest regeneration would be monitored both inside and outside the exclosures as described under Alternative A. Additional monitoring of the 30 exclosures would also be conducted on a 3-year rotation, with 10 large exclosures (and adjacent paired open plots) monitored each year for a select set of variables.

Vegetation monitoring for action threshold determination in this and other action alternatives requires the addition of 8 to 12 trillium monitoring sites (1 × 1 meter (one meter is about 3.28 feet) exclosures) and 13 small-scale woody plant monitoring sites (10 × 10 meter exclosures) beyond the number of existing monitoring sites described under Alternative A.

Deer Population

The park would conduct fawn surveys during the summer to monitor reproductive control effectiveness, in addition to the ongoing spotlight/distance sampling. Data collected would include numbers of fawns observed during a 3-night survey in the summer, as well as numbers observed for duration of the spotlight surveys. Additional data used to estimate fawning rates would be collected from observations of the reproductive status of treated deer that are killed by vehicle collisions on roadways within the park.

As explained in “Section 2.4, Elements Common to All Action Alternatives,” the park would initiate opportunistic surveillance to test for the presence of CWD. If a known case of CWD were found within 60 miles of the park, the park would initiate targeted surveillance.

Donation for Consumption or Disposal of Carcasses

The park intends to donate all deer meat to local charitable organizations (e.g., local food banks) to the maximum extent possible, as described in “Section 2.4, Elements Common to All Action Alternatives.” Any deer carcasses recovered (e.g., through CWD surveillance, vehicle collisions, or other mortality) could be offered for donation, assuming that the agent used had been labeled as suitable for human consumption once in the target animal. For example, according to information provided by the EPA on

GonaCon™, there is no known danger associated to humans or wildlife from eating deer that have been vaccinated with GonaCon™.

2.5.2 IMPLEMENTATION COSTS

Costs of implementing Alternative B would include the same costs described under Alternative A plus the costs of constructing, maintaining, and monitoring additional small exclosures (woody plant and trillium monitoring) for action threshold determination; constructing and maintaining 30 large exclosures; reproductive control; and the costs of implementing CWD surveillance. Cost estimates and assumptions are provided in Table 2-6.

Additional Action Threshold Monitoring Sites

Vegetation monitoring for action threshold determination in this and other action alternatives requires the addition of 8 to 12 trillium monitoring sites (1 × 1 meter exclosures; 1 meter is about 3.28 feet) and 13 small-scale woody plant monitoring sites (10 × 10 meter exclosures) beyond the number of existing monitoring sites described under Alternative A. A material and installation estimated cost of $6 per linear foot was used (Ferebee, pers. comm., 2008; Petit, pers. comm., 2011c; Northeast Deer Technical Committee [NDTC] 2009).

Large-scale Exclosures

Thirty large deer exclosures (1,000 feet × 1,000 feet) would be used in selected areas in each management zone to protect larger areas within the park than are currently protected to allow forest regeneration. Material and installation costs are estimated at $6 per linear foot of fence (Ferebee, pers. comm., 2008; Petit, pers. comm., 2011b; NDTC 2009). It is estimated that 10 exclosures would be constructed each year for the first 3 years. Labor to inspect and maintain the large exclosures is estimated at 1 person, half time.

Nonsurgical Reproductive Control

Costs per deer would include costs for the reproductive control agent, labor and equipment, and bait piles. The cost of the selected agent would likely be minimal compared to labor costs for the effort. For example, the estimated cost per dose of the GonaCon™ vaccine is estimated at $2 to $10, but the main cost is associated with capturing the deer to deliver the injection; this cost is estimated at $500 to $1,000 per deer if capture and marking are required (USDA-APHIS 2008/2010). Other control methods that might become available in the future have similar current costs. A study in New York (one of the few conducted on a suburban free-ranging deer population) estimated that the minimum annual time commitment per deer for reproductive control (using PZP) was approximately 20 hours, costing in the range of $450 to $1,000 per deer (Rudolph, Porter, and Underwood 2000). At Cleveland Metroparks (where PZP was used), the cost of labor was about $450 per deer, and the cost of vaccines and equipment was approximately $450 per deer (DeNicola, pers. comm., 2004a). Vaccine trials in Connecticut cost $1,128 per deer for 30 deer over 2 years, with 64 percent of the cost going to labor (Walter, Kilpatrick, and Gregonis 2002).

Costs for remote delivery would likely be less than costs for any capture, but with the uncertainly of the ease of identifying and darting deer that have become wary of human presence, a higher-end figure of $1,000 per deer was used for estimating purposes. However, the costs presented for this alternative could decrease based on improved technology, such as use of remote delivery of the selected agent and efficacy lasting for multiple years. The cost of additional monitoring required for reproductive control would be for two NPS staff members to conduct 3 days of spotlight surveys during the summer to document the number of fawns.

TABLE 2-6: COST ESTIMATE—ALTERNATIVE B: COMBINED NONLETHAL ACTIONS

Action	Assumptions	Annual Cost ($)	Cost for the 15-Year Planning Period ($)
Same actions as described for Alternative A (included in all alternatives)	See Table 2-1		750,930
Construction of additional action threshold vegetation monitoring sites	8–12 1 × 1 m trillium sites and 13 10 × 10 m woody plant monitoring plots- 568 m or 1,863 feet at $6/linear foot	11,178	11,178
Monitoring and maintenance of additional monitoring plots	Figure based on 65% of labor costs in Alternative A	12,917	193,755
Large-scale exclosures	30 exclosures (each exclosure 1,000 x 1,000 ft.) for a total of 120,000 linear ft. at $6 per linear ft. Exclosures installed at rate of 10 per year over 3 years	240,000 per year for first 3 years	720,000
Maintenance of large-scale exclosures	Labor to inspect and maintain exclosures (estimated at 1 person, half time [1040 hours], $32/hr); material costs vary by year	33,280 [a]	499,200 [a]
Nonsurgical reproductive control of does (assuming treatment every 2 years for this analysis, based on using GonaCon™ as an example)	Cost dependent on how many deer treated and on current available technology Assume 90% of does (approx. 750) need to be treated and one-half (375) can be treated every year, at $1,000 per doe	375,000 each year for 15 years [b]	5,625,000 [b]
Reproduction monitoring	2 staff; 3 nights; 5 hr per night of fawn surveys using GS11 at $32/hr; plus data analysis each summer = 20 hrs at $32/hr	1,600	24,000
CWD surveillance and testing	Purchase of testing supplies @ $2500 every 3 years (4 × during 15 yr plan)	2500 every 3 years	10,000
	Opportunistic surveillance costs: 50 deer/year × 1 hr/deer × $32/hr	1,600	24,000
	Annual CWD surveillance training: 2 people × 4 hours × $32/hr	256	3,840
	Targeted surveillance costs: 5 hours × $32/hour × 25 deer exhibiting clinical signs of CWD [c]	4,000	60,000
	CWD testing shipping costs [d]	150	2,250
	Disposal costs: Assumes 50 deer/year at $25/deer for those not suitable for donation, although costs will vary if CWD-positive deer are confirmed	1,250	18,750
		TOTAL	7,942,903

[a] To calculate annual maintenance costs, it was assumed that all 30 exclosures would be built in year 1.

[b] Total cost could be reduced considerably if reproductive control costs could be decreased based on improved technology.

[c] Targeted surveillance costs would only be experienced if CWD were confirmed within 60 miles of the park. The number of deer taken by surveillance would also vary depending on the number needed to reach 99% confidence in detecting CWD if it were present at a prevalence of 1%.

[d] Costs for CWD testing assume that laboratory costs are covered by the existing NPS agreement through the BRMD. If this were not available, costs would most likely be higher.

CWD Surveillance and Testing

Costs associated with surveillance would vary based on the distance of the nearest CWD case from the park (determining whether opportunistic and/or targeted surveillance is occurring). As for opportunistic surveillance and the purposes of cost estimates, the park assumed that up to 50 deer samples would be tested as the opportunity arose (e.g., vehicle collisions or natural causes of death) and would require minor labor costs to prepare the physical sample for testing since opportunistic samples would be obtained through regular work routines. Costs also include those for supplies and equipment.

Should targeted surveillance be initiated (if CWD were confirmed within 60 miles of the park), this would require an NPS staff member to actively locate, sharpshoot or euthanize, and retrieve the clinically suspect deer in the field, which could take 4 to 5 hours, depending on where the deer is found. Since equipment costs are already included in the opportunistic surveillance costs, the park used an estimated cost of $125 per deer to calculate labor costs to perform targeted surveillance (5 hours × $25/hour).

The cost associated with actual CWD testing would vary depending on the proximity of the nearest CWD case and who conducts the testing. For the purposes of this cost estimate, it is assumed that CWD testing would occur under the NPS agreement through the BRMD, although a local arrangement may be possible and would affect costs. Thus, minor costs of shipping the samples for testing are included in the cost estimate below.

Given the limited number of deer that would be removed and considered for donation under this alternative, if any, it is assumed that any meat being considered for donation would be stored with a local processor, if one is available and willing (i.e., refrigeration costs are not included), and that processing costs would be minor; therefore, these costs are not included below.

It is unknown how many carcasses will need to be disposed of. Cost estimates assume that 50 carcasses would need to be disposed of via landfill (e.g., those not suitable for donation) at $25/carcass. Should CWD-positive carcasses be identified, disposal through alkaline digestion or incineration, if not by landfill, would affect costs. Incineration may cost $1 to $2.50/lb., or approximately $100 to $250/deer, but the costs for alkaline digestion may be lower than incineration.

2.6 ALTERNATIVE C: LETHAL ACTIONS (SHARPSHOOTING AND CAPTURE/EUTHANASIA)

Alternative C would continue the actions described under Alternative A in addition to those common to all action alternatives. Additional actions would include the combination of lethal reduction through sharpshooting with firearms and the use of capture and euthanasia in circumstances where sharpshooting would not be appropriate to reduce the deer population. These actions would be used to achieve initial deer density goals of 15 to 30 deer per square mile, and the population would be maintained at an appropriate density over time as determined by adaptive management. All actions would be managed by NPS personnel and carried out by qualified federal employees and authorized agents as described in “Section 2.4, Elements Common to All Action Alternatives.”

2.6.1 ADDITIONAL PROPOSED ACTIONS UNDER ALTERNATIVE C

Sharpshooting

Methods

Qualified federal employees or contractors would be used to implement this alternative. All employees or contractors used would be experienced with sharpshooting methods and would have the necessary sharpshooting qualifications. They typically would be expected to coordinate all details related to sharpshooting actions, such as setting up bait stations, locating deer, sharpshooting, and disposition of the deer (donation of meat and/or disposal of waste or carcasses).

In most locations, high-powered, small-caliber rifles would be used from close range. Nonlead ammunition would be used for any lethal removal of deer, whether for culling or for dispatching sick or wounded wildlife. The use of nonlead ammunition for these activities, whether by contract or NPS staff, will be carried out in order to preserve the opportunity to donate the meat or to leave it in the field for scavenging wildlife. Every effort would be made to make the shootings as humane as possible. Deer injured during the operation would be put down as quickly as possible to minimize suffering. Noise suppression devices (silencers) and night vision equipment would be used to reduce disturbance to the public. Activities would be in compliance with all federal firearm laws administered by the ATF.

Sharpshooting would primarily occur at night (between dusk and dawn) during late fall and winter months when deer are more visible and few visitors are in the park. In some areas, sharpshooting might be conducted during the day or at other times of year if needed to maximize effectiveness and minimize overall time of visitor restrictions. Areas could be temporarily closed to park visitors, and NPS park rangers would patrol public areas to ensure compliance with park closures and public safety measures. The public would be notified of any park closures in advance. Information regarding deer management would be available at visitor contact facilities, and information would be posted on the park's website to inform the public of deer management actions.

Personnel assisting with direct reduction activities would participate in training. Training would include safety measures to protect both visitors and NPS employees. If more than one shooting location were used, areas would be adequately separated to ensure safety. Bait stations could be used to attract deer to safe removal locations and would consist of small grains, apples, hay, or other food placed on the ground. The stations would be placed in park-approved locations away from public use areas to maximize the efficiency and safety of the reduction program. The amount of bait placed in any one location could range from 20 to 100 pounds per day, depending on the bait used and the number of deer in the immediate area (DeNicola, pers. comm., 2004b).

Number of Deer Removed

Based on the 2010 survey, the park deer population is estimated at 1,669 deer. Park staff would determine the number of deer to be removed from the park based on the most recent population survey and the initial deer density goal of 15 to 30 deer per square mile, as well as past experience by Cleveland Metroparks and other deer management programs. Based on parkwide deer density, it is estimated that about four years would be required to reach the midpoint of the desired deer density goal, given the number of deer that could be successfully removed. The following table (Table 2-7) and Figure 2-4 illustrate the reduction in deer that would occur over the years to reach the desired deer density goal.

TABLE 2-7: EXPECTED DEER POPULATION REDUCTION UNDER REMOVAL PROGRAM

Year	Total number of deer [a]	Number of deer removed [b]	Number of deer following removal	Deer Density following removal (deer/sq. mile)
1	1,669	375	1,294	32
2	1,553	375	1,178	29
3	1,414	375	1,039	26
4	1,247	375	872	21 [c]
5 and beyond	1,046	175	871	21

[a] Includes 20% annual growth after year 1.

[b] Assumes that every year 15 deer need to be removed using capture and euthanasia; the rest are removed using sharpshooting.

[c] Approximately the midpoint of the desired deer density range of 15–30 deer per square mile; subject to the results achieved in the vegetation monitoring through adaptive management.

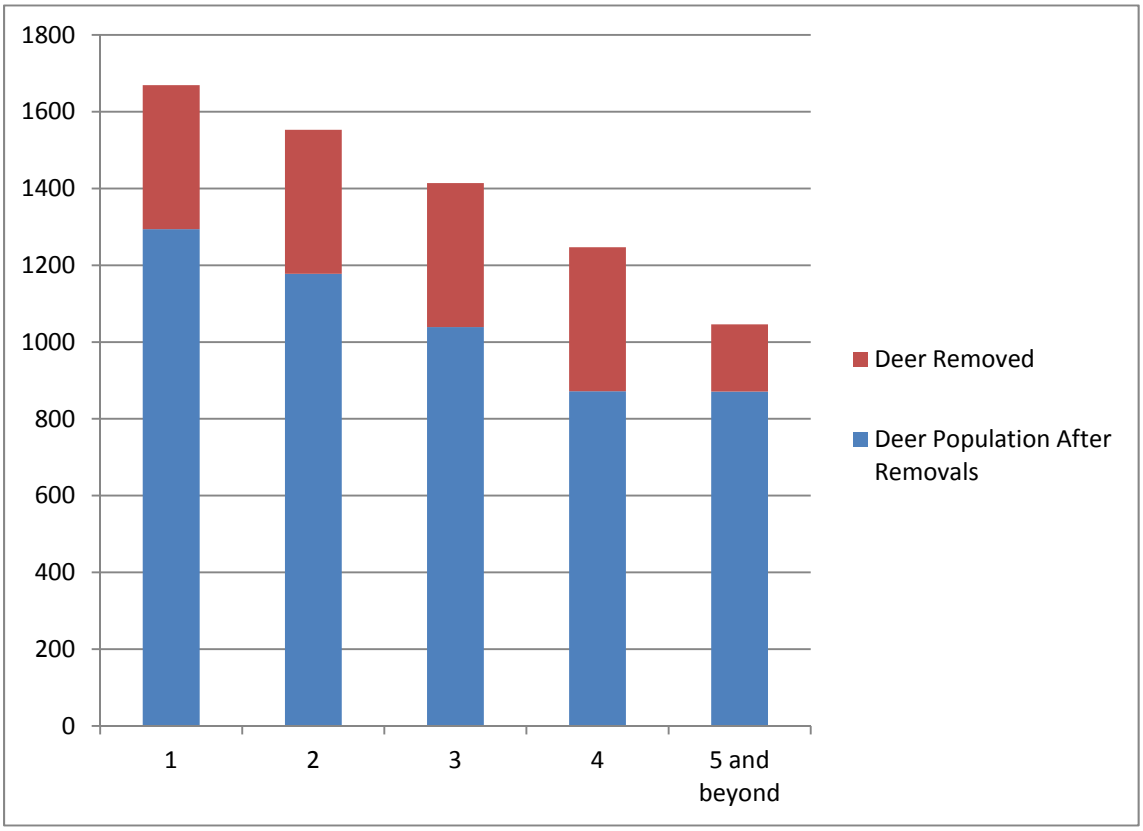


FIGURE 2-4: EXPECTED DEER POPULATION SIZE UNDER REMOVAL PROGRAM

Several factors could influence the actual number of deer removed, the zones targeted for removal, and actual densities within the zones. For example, if deer densities remain lower in all zones except zone 5, efforts to remove deer and the desired removal number would likely be set higher for zone 5, where densities have remained between 60 and 80 deer per square mile over many years. Removals could be concentrated in zones where vegetation monitoring continues to show the most severe adverse impacts on

herbaceous and/or woody vegetation. Also, several factors could influence the number of years required to reach the initial deer density goal. As the deer population decreased through successful reduction efforts, deer might become adapted to the sharpshooting operations and become more evasive, increasing the effort necessary to reach the removal numbers in any year. Existing reproduction and mortality rates might differ from the estimate 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 would potentially 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 fewer deer having to be removed and the deer density goal being reached in less time. Immigration of deer into the park could also have an effect on the number of deer to be removed (Porter, Underwood, and Woodard 2004). Thus, monitoring would be an essential part of this alternative, and actions could be adjusted as described in "Section 2.8, Adaptive Management Approaches Included in the Alternatives."

The number of females in the population would also influence reproduction rates. Because does would be preferentially removed (see the following section), reproduction rates should decrease because fewer females would be reproducing.

Gender Preference

Both does and antlered deer (bucks) would be removed based on opportunity, although there would be a preference for removing does because this would reduce the population level more efficiently over the long term. Buck-only removal would not control population growth, as deer populations are largely dependent on the number of does with potential for reproduction (West Virginia University 1985).

Records would be kept on the age and gender of all deer removed from the park to aid in defining the local population composition. This information would be compared with composition data collected during park population surveys.

Capture and Euthanasia

Capture and euthanasia would be used in circumstances where sharpshooting would not be appropriate due to safety or security concerns. The preferred technique for this method would be for qualified federal employees or authorized agents to trap deer, approach them on foot, and euthanize them. Activities would occur at dawn or dusk when fewer visitors are in the park, and it is assumed that about 15 deer per year would need to be removed in this manner.

Because capture and euthanasia would typically result in increased stress levels in captured deer compared to sharpshooting, this method of population control would be used only in select situations and would supplement the sharpshooting method described earlier only when necessary.

The number of deer removed by capture and euthanasia would be recorded, as well as the age and sex of the deer, location of removal, circumstances requiring removal and capture, and lethal method used.

Capture Methods

Deer would be captured with nets or traps, similar to the trapping described under the reproductive control option. The method of capture would be selected based on the specific circumstances (e.g., location, number of deer, accessibility, and reasons why sharpshooting is not advised) for each deer or group to be removed. Captured deer would be euthanized as humanely as possible, in accordance with current veterinary recommendations such as those published by AVMA (2007).

Deer could also be immobilized by darting with a tranquilizer gun (Schwartz et al. 1997). This method could be used in cases where deer had not been successfully attracted to a trap area.

Euthanasia Methods

Euthanasia methods could include a combination of penetrating captive bolt gun and potassium chloride, firearm technique, or other humane technique. If for some reason the penetrating captive bolt gun or firearm technique could not be used to euthanize a trapped animal, injecting a lethal dose of a drug (under supervision of a veterinarian or NPS park practitioner) could be used. However, if chemicals were used either for immobilization or for euthanasia, it will not be possible to donate the meat from that animal as food, and the carcass might be unsuitable for surface disposal. In this case, the carcasses would be taken to a local landfill as described in "Section 2.4, Elements Common to All Action Alternatives."

Qualifications/Training

NPS staff and authorized agents trained in the use of penetrating captive bolt guns, firearms, or tranquilizer guns would perform these euthanasia actions. Training would include safety measures to protect authorized agents, visitors, and NPS employees. Authorized agents may also need to be qualified to handle live deer in order to prevent disease transmission and prevent any harm to the handler. Appropriate safety measures would be followed when setting drop nets or box traps.

Monitoring

Vegetation

Throughout the removal actions, vegetation monitoring would be conducted to document any changes in deer browsing and forest regeneration that might result from reduced deer numbers, following the monitoring protocol outlined in Appendix B. Vegetation monitoring would be conducted annually to document vegetation recovery. If the park objectives were being met and forest regeneration was successful at the initial deer density goal, removal efforts would be maintained at the level necessary to keep the deer population at the target density. However, it would take several years for vegetation to respond to lower deer numbers and this response would directly depend on how quickly the population was reduced. Likewise, the number of deer to be removed in subsequent years would be adjusted based on the success of previous removal efforts, projected population size, and vegetation and deer monitoring results. Park management could adjust the removal goal in either direction from the initial density goal depending on how well the park's forest regeneration objectives had been met (see "Section 2.8, Adaptive Management Approaches Included in the Alternatives").

Vegetation monitoring for action threshold determination in this and other action alternatives requires the addition of 8 to 12 trillium monitoring sites (1 × 1 meter exclosures; one meter is about 3.28 feet) and 13 small-scale woody plant monitoring sites (10 × 10 meter exclosures) beyond the number of existing monitoring sites described under Alternative A.

Deer Population

Deer population numbers would be monitored through the ongoing monitoring efforts discussed under the no action alternative and in "Chapter 1: Purpose of and Need for Action." The park would use annual spotlight surveys and distance sampling to document trends in population size.

Opportunistic and/or targeted surveillance for CWD would be conducted as described in "Section 2.4, Elements Common to All Alternatives," depending on the proximity of the nearest confirmed CWD case.

Under Alternative C, a greater number of carcasses would be available for opportunistic testing because of lethal reduction activities as compared to Alternative B.

Donation for Consumption or Disposal of Carcasses

The park intends to donate all deer meat to local charitable organizations to the maximum extent possible. Deer removed through lethal reduction would be transported by federal employees or authorized agents to a central location for temporary storage during removal actions and collection of biological data and tissue samples for CWD testing. Testing would occur to the maximum extent possible and to the required detection level of confidence as described in "Section 2.4, Elements Common to All Action Alternatives." Deer would only be donated for consumption if they are confirmed CWD-negative deer or if the required detection confidence level indicates that CWD is not present within the population.

In cases where one to a few deer at a given site were shot or euthanized (without chemical use) and when CWD is not known to exist within 60 miles of the park, the waste or carcasses could be moved away from roads and trails and scattered and left on the surface to be naturally scavenged and/or decomposed (see "Surface Disposal of Deer" in "Section 2.4, Elements Common to All Action Alternatives").

In cases where the meat from deer was unsuitable for donation to charity or for surface disposal and CWD was not present, the carcasses and waste would be collected for disposal in an approved local landfill (see "Disposal of Deer Carcasses Not Suitable for Consumption or Surface Disposal" in "Section 2.4, Elements Common to All Action Alternatives").

2.6.2 IMPLEMENTATION COSTS

Costs of implementing Alternative C would include the same costs described under Alternative A, plus the cost of additional vegetation monitoring for action threshold determination described under Alternative B, costs of sharpshooting and capture/euthanasia, and CWD surveillance and testing costs. Estimated costs for this alternative are summarized in Table 2-8 and discussed below.

Additional Action Threshold Monitoring Sites

Vegetation monitoring for action threshold determination in this and other action alternatives requires the addition of 8 to 12 trillium monitoring sites (1 × 1 meter exclosures; one meter is about 3.28 feet) and 13 small-scale woody plant monitoring sites (10 × 10 meter exclosures) beyond the number of existing monitoring sites described under Alternative A. Cost estimates are the same as in Alternative B.

Sharpshooting

Factors affecting the cost of implementing this alternative include deer density, the number of deer to be removed, the ease of access to deer, the number and location of bait stations, equipment availability, the amount of data to be collected from deer, and processing requirements. The greatest costs would generally be incurred when the deer and bait stations were difficult to access, when deer were evasive of humans, when the removal area was large, and when deer densities were lower (requiring more time to find each deer). Conversely, lower costs could be expected when the removal area was smaller, deer density was high (requiring less time to find each deer), and deer were accustomed to human activities (DeNicola, pers. comm., 2004b). For cost estimating it is assumed that a qualified federal employee or contractor would conduct the lethal removal activities, process the deer, collect biological data, prepare meat for transfer to a local food bank (as appropriate), and/or arrange for disposal of deer carcasses.

TABLE 2-8: COST ESTIMATE—ALTERNATIVE C: LETHAL ACTIONS

Action	Assumptions	Annual Cost ($)	Cost for the 15-year Planning Period ($)
Same actions as described for Alternative A (included in all alternatives)	See Table 2-1		750,930
Construction of additional action threshold vegetation monitoring sites	8–12 (1 × 1 m) trillium exclosure sites and 13 10 × 10 m woody plant monitoring plots	11,178	11,178
Monitoring and maintenance of additional monitoring plots	Figure based on 65% of labor costs in Alternative A	12,917	193,755
Sharpshooting [a]	Years 1–4: 360 deer removed annually ($200/deer) [b] Years 5–15: 160 deer removed each year for 11 years ($200/deer) [b]	Years 1–4: 72,000 annually Years 5–15: 32,000 annually	Years 1–4: 288,000 Years 5–15: 352,000 [c]
Capture and euthanasia	15 deer /year (average $500/deer) [d]	7,500	112,500
CWD surveillance and testing	Opportunistic surveillance costs to obtain physical sample for testing: Years 1–4: 375 deer/year × 80% × $20/deer Years 5–15: 175 deer × 80% × $20/deer	Years 1–4: 6,000 Years 5–15: 2,800	Years 1–4: 24,000 Years 5–15: 30,800
	Shipping samples for testing [e]	400	6,000
	Targeted surveillance costs: 5 hours × $32/hour × 25 deer exhibiting clinical signs of CWD[f]	4,000	60,000
Donation for consumption or disposal of carcasses	Refrigerated storage of deer while awaiting CWD test results	5,000	75,000
	Assuming $125/deer for preparation, refrigeration, and transport: Years 1–4: 375 deer × $125/deer Years 5–15:175 deer × $125/deer	Years 1–4: 46,875 annually Years 5–15: 21,875 annually	Years 1–4: 187,500 Years 5–15: 240,625
	Disposal costs – assumes 100 deer/year @ $25/deer for those not suitable for donation, although costs will vary if CWD-positive deer are confirmed	2,500	37,500
		TOTAL	**2,369,788**

[a] Cost would be further influenced by whether or not volunteers are used to assist with supporting duties (e.g., non-shooting assistance such as bait pile construction).

[b] Assume cost/deer remains about the same over the years, based on experience at Gettysburg National Battlefield over several years; however, additional costs may be incurred if additional time is needed to locate and remove deer at a lower deer density or if additional park staff is needed for securing the park.

[c] This cost could increase if the deer density goal were not reached by year 4.

[d] Costs for this method would vary but are estimated in the middle of the range.

[e] Costs for CWD testing assume that laboratory costs are covered by the existing NPS agreement through the BRMD. If this were not available, costs would most likely be higher.

[f] Targeted surveillance costs would only be experienced if CWD were confirmed within 60 miles of the park. The number of deer taken by surveillance would also vary depending on the number needed to reach 99% confidence in detecting CWD if it were present at a prevalence of 1%.

Cost and efficiencies of sharpshooting programs have been assessed in the literature and costs estimates are available from programs that have involved sharpshooting of deer over the past few years. One study

documented that costs ranged from $72 to $260 per deer harvested (Warren 1997). A study in Minnesota compared methods to reduce deer abundance, and sharpshooting averaged $121 per deer harvested (Doerr, McAnnich, and Wiggers 2001). Gettysburg National Military Park recently reported costs of about $200 per deer, not including processing and deer counts(Bolitho, pers. comm., 2010; Koenig, pers. comm., 2011), and the staff at Valley Forge National Historic Park agreed with a $200/deer estimate (Heister, pers. comm., 2011). Cleveland Metroparks was contacted for a recent estimate, and it was difficult to get an exact figure because of many variables, including the cost of fixed items such as guns, ammunition, and vehicles. Based on the overall dollars reported spent (Tyler, pers. comm., 2011b), costs (including labor for site security) were estimated to be about $150 to $232 per deer. Gettysburg staff report that they have not seen a big increase in cost per deer over the years, even though the deer numbers have declined substantially.

Based on this information, it is estimated that sharpshooting at Cuyahoga Valley National Park would cost $200 per deer and that this is a valid estimate for succeeding years. It is recognized that costs will vary, depending on availability of capital equipment, contract vs. park labor, need for site security, and number of deer.

Capture and Euthanasia

The costs for capturing deer would likely vary. Factors would include the location of the removal, accessibility, type of trap or immobilization drug used, the means of deer disposal, and the type of euthanasia used. Based on the experience of park personnel and the range of costs identified for capturing deer under the reproductive control action, costs could range from $100 to $1,000 per deer. An experienced contractor estimates that the minimum cost for capture and euthanasia would be $400 per animal (White Buffalo, Inc. n.d.); therefore, actual costs for this method would likely be closer to the lower to middle end of the range ($500).

CWD Surveillance and Testing

It is assumed that costs of CWD opportunistic surveillance (and targeted surveillance if CWD were confirmed within 60 miles of the park) would be greater than estimated under Alternative B, because there would be a greater opportunity to test deer for CWD given the lethal actions in this alternative and due to the possibility of donation for consumption. Therefore, a percentage of deer (80 percent) to be removed was used in estimating the costs of CWD testing.

Carcasses would be stored within the park in a refrigerated storage trailer as necessary (e.g., while awaiting CWD test results). The boxcar/truck would be located within a secured area within the park. Costs associated with purchase of a refrigerated boxcar are expected to be approximately $75,000. Alternatively, costs for leasing a refrigerated storage trailer would include the monthly leasing and fuel costs (approximately $1,000 and $450/month). The purchase or lease of refrigerated storage means would depend on the length of time the refrigeration is needed over the lifetime of the plan. Purchase costs are assumed for the purposes of the cost estimate below.

Donation for Consumption or Disposal of Carcasses

For the purposes of this analysis, it is assumed that meat will be donated to the maximum extent possible. An estimated 80 percent of the deer removed will be tested for donation, given that some carcasses will not be suitable for donation or will be left on the surface. Recent information obtained from Cleveland Metroparks indicates that it costs approximately $122/deer to field dress, refrigerate, and transport carcasses for donation or disposal (Tyler, pers. comm., 2011b). MPSSC estimated about $125/deer for

preparation and transport for processing (Petit, pers. comm., 2008d). Therefore, the cost estimate assumes $125/deer for preparation and transport for processing.

Should a confirmed case of CWD be located within 60 miles of the park, costs may vary given that a higher detection level of confidence would be necessary to determine whether meat is suitable for consumption (a greater sample size may need to be tested). Additionally, the deer population in the area may be variable, which would affect the number of deer available to be taken.

Should a confirmed case of CWD be located within the park, costs would still be incurred by CWD testing to determine prevalence. However, costs of processing the meat for donation may vary or not be incurred at all, depending on guidance from public health officials. (Donation to third-party entities for distribution would be prohibited if CWD were confirmed within the park's deer population.) In this case, CWD-positive deer would be disposed of through alkaline digestion or incineration or would be disposed of in a local landfill as described in "Section 2.4, Elements Common to the Action Alternatives." Since the cost estimate assumes costs of disposal by landfill, disposal costs listed below are slightly higher than in Alternative B because it is assumed that a number of deer would be unsuitable for donation given the larger number of deer to be removed under this alternative.

The cost for shipping samples for testing is estimated to be higher than under Alternative B, given the likelihood that a larger number of samples would be tested under this alternative for opportunistic surveillance reasons or given the possibility of donation for consumption. Costs of disposal through alkaline digestion or incineration would vary as described under Alternative B.

2.7 ALTERNATIVE D: COMBINED LETHAL AND NONLETHAL ACTIONS

Alternative D would include all actions described under Alternative A and "Section 2.4, Elements Common to all Action Alternatives," plus a combination of some of the nonlethal and lethal actions from Alternatives B and C to reduce deer herd numbers. The lethal actions would include both sharpshooting and capture/euthanasia, and these actions would be taken initially to reduce the deer herd numbers quickly. Nonsurgical reproductive control of does would then be implemented to maintain the reduced herd numbers if an acceptable reproductive control agent is available; sharpshooting would be used as a back-up method, if no acceptable agent is available. All actions would be carried out by NPS personnel or their authorized agents, as described in "Section 2.4, Elements Common to All Action Alternatives."

2.7.1 ADDITIONAL PROPOSED ACTIONS UNDER ALTERNATIVE D

Sharpshooting

Direct reduction by sharpshooting would be used to initially reduce the deer population in areas of the park and as a maintenance treatment if needed. Methods described in Alternative C would be implemented. This action would begin in the first year of the plan, would continue through year 4, and for maintenance purposes could still be used depending on the deer density and availability of an acceptable reproductive control agent. In years 1 through 4, 360 deer would be removed by sharpshooting (in addition to those removed by capture and euthanasia) to meet the initial deer density goal.

Capture and Euthanasia

Capture and euthanasia would be implemented sparingly in areas where sharpshooting is not possible, as described under Alternative C. This procedure would include trapping or immobilizing deer using a

technique designed to create the least amount of stress. It is assumed that 15 deer would be removed using this method in all years.

Nonsurgical Reproductive Control

Reproductive control would be implemented, as described under Alternative B, to maintain the deer population at the deer density goal if an acceptable reproductive control agent is available. Reproductive control may need to be implemented in conjunction with lethal efforts used as a back-up method.

Assuming reproductive control was initiated when the park's deer population density was at the midpoint of the initial deer density goal (about 21-22 deer per square mile) at the end of year 4 management, the park's total deer population would be approximately 872. However, assuming that the population grows by 20 percent before reproductive control would be initiated the following fall, there would be about 1,046 deer in year 5, or 523 does. To treat 90 percent or 471 does would not be practical within the 5-month preferred window to do this (November to March), and it would be best to treat all does at one time. Therefore, the park would conduct an initial reduction of 175 deer (160 by sharpshooting and an assumed 15 taken by capture and euthanasia) in late October to again reach a deer density of 21 deer/mi^2 or 872 deer. At this number, there would be 436 does; 90 percent of which is 392, which can be treated over 5 months at 4 does per day (weekdays only), as described under Alternative B. These deer would need to be treated every 2 years and marked for identification for subsequent retreatment in order to reduce the population.

The population would continue to be monitored for growth. If the deer population increased during the reproductive control application under this alternative, periodic direct reduction may need to be conducted in conjunction with the reproductive control to maintain the population density at the identified goal.

The success of implementing reproductive control on a population that had undergone direct reduction for several years would depend on advances in reproductive control technology, sensitivity of the deer herd to humans, methods used by the sharpshooters, changes in immigration with reduced deer density, and general deer movement behavior (Porter, Underwood, and Woodard 2004; Naugle et al. 2002).

Monitoring

Monitoring would include the same techniques described under Alternative C for sharpshooting and capture and euthanasia and described under Alternative B for reproductive control. Monitoring techniques would also include the current actions described under Alternative A.

CWD Surveillance and Testing

Opportunistic and targeted surveillance (if CWD were confirmed within 60 miles of the park) would occur as described under Alternative C and in "Section 2.4, Elements Common to All Action Alternatives."

Donation for Consumption or Disposal of Carcasses

The NPS would donate deer meat to local charitable organizations to the maximum extent possible, or dispose of carcasses as described in "Section 2.4, Elements Common to All Action Alternatives" and under Alternatives B and C, depending on the proximity of the nearest confirmed CWD case and results of CWD testing.

2.7.2 IMPLEMENTATION COSTS

Alternative D would include the same costs described under Alternative A, plus additional costs for sharpshooting, capture and euthanasia, reproductive control, monitoring, CWD surveillance and testing, and donation or disposal similar to those costs in Alternative C. Differences in costs from Alternative C are summarized in Table 2-9 and discussed below.

TABLE 2-9: COST ESTIMATE—ALTERNATIVE D: COMBINED LETHAL AND NONLETHAL ACTIONS

Action	Assumptions	Annual Cost ($)	Cost for the 15-Year Planning Period ($)
Same actions as described for Alternative A (included in all alternatives)	See Table 2-1		750,930
Construction of additional action threshold vegetation monitoring sites	8–12 (1 × 1 m) trillium exclosure sites and 13 (10 × 10 m) woody plant monitoring plots	11,178	11,178
Monitoring and maintenance of additional monitoring plots	Figure based on 65% of labor costs in Alternative A	12,917	193,755
Sharpshooting [a]	Years 1–4: 360 deer removed annually ($200/deer); year 5- 160 deer removed prior to start of reproductive control ($200/deer) [b]	Years 1–4: 72,000 annually Year 5 – 32,000	320,000
Capture and euthanasia	Assume a maximum of 15 deer per year taken in this manner	7,500 [c]	112,500
Nonsurgical reproductive control	Years 5–15: 90% of does (392) treated every two years Cost dependent on number of deer treated and current available technology (assumes $1,000/doe) [d]	Years 5–15: 392,000 every 2 years- assume 6 treatments in years 5,7,9,11,13,15	2,352,000
Reproduction monitoring	2 staff; 3 nights; 5 hr per night of fawn surveys using GS11 at $32/hr; plus data analysis each summer = 20 hrs at $32/hr - in years 6 through 15 (10 years)	1,600	16,000
CWD surveillance and testing	Opportunistic surveillance costs to obtain physical sample for testing: Years 1–4: 375 deer/year × 80% × $25/deer Year 5 (early fall removal): 160 deer × $25/deer Years 5–15: 15 deer × $25/deer each year	Years 1–4: 7,500 Year 5 early removal: 4,000 Years 5–15: 375	Years 1–4: 30,000 Year 5: 4,000 Years 5–15: 4,125
	Shipping samples for testing [e]	400	6,000

Action	Assumptions	Annual Cost ($)	Cost for the 15-Year Planning Period ($)
	Targeted surveillance costs: 5 hours × $32/hour × 25 deer exhibiting clinical signs of CWD[f]	4,000	60,000
Donation or disposal	Refrigerated storage of deer while awaiting CWD test results	5,000	75,000
	Assumes $125/deer for preparation, refrigeration, and transport Years 1–4: 375 deer × $125/deer Year 5 early fall removal: 160 deer × $125/deer Years 5–15: 15 deer × $125/deer	Years 1–4: 46,875 annually Year 5- 20,000 Years 5–15: 1,875	Years 1–4: 187,500 Years 5–15: 40,625
	Disposal costs: Same as Alternative C, assumes 100 deer/year @$25/deer for those not suitable for donation, although costs will vary if CWD-positive deer are confirmed	2,500	37,500
		TOTAL	**4,201,113**

[a] This cost could increase if the deer density goal was not reached by year 4.

[b] Assume cost/deer remains about the same over the years, based on experience at Gettysburg National Battlefield over several years; however, additional costs may be incurred if additional time is needed to locate and remove deer at a lower deer density or if additional park staff is needed for securing the park.

[c] Costs for this method would vary but are estimated in the middle of the range.

[d] Reproductive control costs could be reduced considerably with improved technology.

[e] Costs for CWD testing assume that laboratory costs are covered by the existing NPS agreement through the BRMD. If this were not available, costs would most likely be higher.

[f] Targeted surveillance costs would only be experienced if CWD were confirmed within 60 miles of the park. The number of deer taken by surveillance would also vary depending on the number needed to reach 99% confidence in detecting CWD if it were present at a prevalence of 1%.

Additional Action Threshold Monitoring Sites

Vegetation monitoring for action threshold determination in this and other action alternatives requires the addition of 8 to 12 trillium monitoring sites (1 × 1 meter exclosures; 1 meter is about 3.28 feet) and 13 small-scale woody plant monitoring sites (10 × 10 meter exclosures) beyond the number of existing monitoring sites described under Alternative A. Cost estimates are the same as those in Alternative B.

Sharpshooting

The cost for using sharpshooting to reduce the overall population size would be the same as in Alternative C for years 1 through 4 and the early fall reduction in year 5.

Capture and Euthanasia

The cost for using capture and euthanasia to supplement the sharpshooting effort would be the same as for Alternative C; it is assumed that 15 deer would be removed this way every year.

Nonsurgical Reproductive Control

For the purposes of this analysis, it is assumed that 90 percent of does would be treated with an acceptable reproductive control agent every 2 years after the initial deer density was met to maintain the population level. Costs could be reduced considerably depending on direct reduction efforts and the cost per deer based on current technology. See Alternative B for a description of the cost per deer assumptions.

Monitoring costs would be the same as those described in Alternative C.

CWD Surveillance and Testing

The costs of CWD surveillance and testing would be less than those under Alternative C because sharpshooting would be used only initially, and capture and euthanasia would result in fewer samples over the years, resulting in lower labor estimates are used in Table 2-9.

Donation for Consumption or Disposal of Carcasses

The NPS would donate deer meat to local charitable organizations to the maximum extent possible, or dispose of carcasses as described in “Section 2.4, Elements Common to All Action Alternatives” and under Alternatives B and C, depending on the proximity of the nearest confirmed CWD case and results of CWD testing.

2.8 ADAPTIVE MANAGEMENT APPROACHES INCLUDED IN THE ALTERNATIVES

The Department of the Interior requires that its agencies “use adaptive management to fully comply” with the Council on Environmental Quality (CEQ) guidance that requires “a monitoring and enforcement program to be adopted … where applicable, for any mitigation” required in a NEPA planning process (516 Departmental Manual [DM] 1.3 D[7]; 40 CFR 1505.2). In addition, the department has recently outlined the adaptive management approach in a technical guide developed to provide guidance to all of its bureaus and agencies (Williams, Szaro, and Shapiro 2007).

According to the technical guide:

> Adaptive management is a systematic approach for improving resource management by learning from management outcomes…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. 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.

Adaptive management should be used when decisions must be made despite uncertainty and where there is a commitment to using this approach. In addition to these two primary conditions, adaptive

management should be used when (1) there is a real management choice to be made, (2) there is an opportunity to apply learning, (3) clear and understandable objectives can be identified, (4) the value of information gained is high, (5) uncertainty can be expressed as models that can be tested, and (6) monitoring is in place or can be put in place to reduce uncertainty (Williams, Szaro, and Shapiro 2007). The deer management situation at Cuyahoga Valley National Park meets all these conditions.

Using the Adaptive Management Process

Adaptive management requires an examination of a hypothesis to be tested. For this plan, adaptive management starts with the hypothesis that deer density is the primary factor limiting woody and herbaceous vegetation generation. Monitoring under this plan would test for significant differences in seedling growth and trillium reproduction between open plots and exclosed plots. If there are differences, then deer management actions would be taken as described in "Section 2.3.2, Threshold for Taking Action." If not, data would be examined to identify the most important variables affecting plant regeneration. These could include light penetration, soil quality, or impacts of other organisms, in addition to deer density.

There are two phases involved for a successful adaptive management plan. These are the set-up phase and the iterative phase (see Figure 2-5) (Williams, Szaro, and Shapiro 2007). The next section demonstrates how Cuyahoga Valley National Park would implement adaptive management through each of the two phases, following the technical guidance.

Set-up Phase

Step 1: Without active stakeholder involvement, an adaptive management process is unlikely to be effective. Stakeholders were identified during internal scoping and were conferred with during the public scoping process through public meetings and comments. In addition, the NPS convened a science team to assist in developing action thresholds and the initial deer density goal.

Step 2: Objectives were prepared at the internal scoping meeting as part of the NEPA process and are detailed in "Chapter 1: Purpose of and Need for Action." Thresholds/metrics relating to vegetation condition and deer density were developed to measure success in meeting plan objectives.

Step 3: Alternative management actions were defined in an alternatives development meeting, using input from the public scoping comments and the science team. Elements of the alternatives were discussed and refined by the interdisciplinary team throughout the NEPA process. These actions were developed to test management hypotheses relating to deer management.

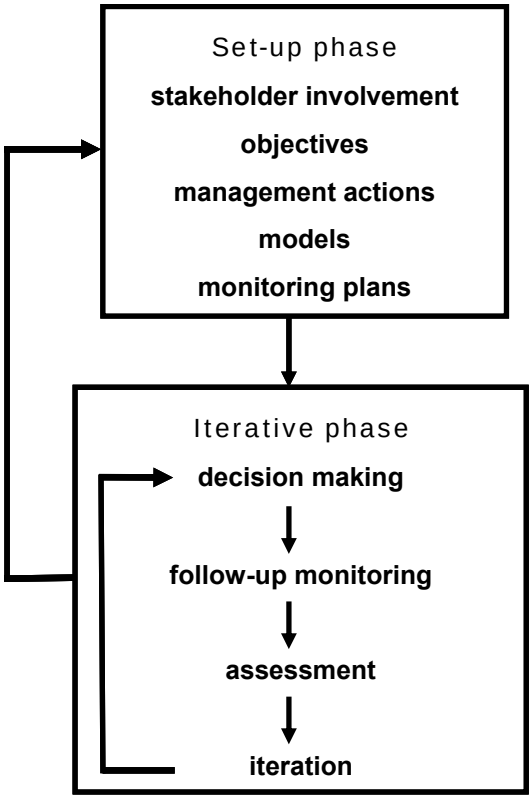


FIGURE 2-5: AN ILLUSTRATION OF THE ADAPTIVE MANAGEMENT APPROACH

Step 4: The park and science team discussed the natural resource system dynamics in terms of how deer and management actions could impact the park's resources. Questions that will be monitored through existing and proposed monitoring actions in this plan to help better understand system dynamics at the park include the following:

- What is the magnitude of white-tailed deer effects on forest growth? (Existing and additional proposed trillium and seedling growth monitoring in all zones.)
- What is the change in forest vegetation over time? (Existing ecological monitoring of changes in vegetation and tree regeneration.)
- What is the change in density of deer in the park over time? (Existing deer distance sampling.)

Step 5: Monitoring programs would be created to collect data related to the testing of hypotheses and to enhance operational models. The data would be used later in the iterative phase to assess whether the objectives are being met. The vegetation data in deer exclosures and vegetation monitoring plots would be used in this assessment. Monitoring data would be documented and made available to the public.

Iterative Phase

Step 1: A management action would be recommended by the park (preferred alternative) and a decision made by the Regional Director. A record of decision (ROD) would be completed. A plan would be developed to implement the selected alternative and to monitor the results (changes in the resources expected from reduced deer density).

Step 2: The park would implement the monitoring plan outlined in Appendix B and collect data on key elements that will measure the success of the selected action and of the park meeting its objectives.

Step 3: The park would evaluate the results of the monitoring, comparing actual outcome with desired condition or objectives. Monitoring data would be analyzed and made available to the public. Based on the assessment, the park may change models, modify the action (e.g., increase or decrease the number of deer taken) or make adjustments in monitoring (look at different parameters or species to measure). The NPS will undertake additional NEPA compliance as necessary, if actions proposed as a result of adaptive management have not been evaluated in this NEPA document.

Step 4: This iteration step can lead back to the set-up phase if substantial changes are needed or to step 1 of the iterative phase if there is a need to adjust the management action through subsequent decision making.

Potential Adaptive Management Approaches

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

Action Threshold

The action threshold could be modified based on the best available data for forest regeneration in a similar forest type, results of monitoring plot data, and deer density changes. Monitoring data would be compared to expectations (that forest regeneration would increase as deer density decreased). It is expected that it would take at least 10 years from the time that deer density was lowered until forest regeneration results would be realized in the monitored plots. If results after 10 years following achievement of the initial deer density goal did not meet expectations based on the action thresholds, the

action threshold would be evaluated along with the monitoring data to determine what adjustments might be necessary.

Deer Removal Goal

For alternatives that would directly reduce the deer population through removal, the number of deer to be removed annually would be adjusted based on the results of the previous year's removal effort, the monitoring of forest regeneration, deer population density surveys, and growth projections. When a management action was first triggered, 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 (15 to 30 deer per square mile). However, because this density goal may not be achieved in 1 year in all areas of the park, annual removal goals would be revised based on the number of deer remaining in the herd after each year's removal actions and factoring in an annual growth rate. This process of determining the number of deer to be removed each year would be repeated until the herd density goal was reached**.**

However, because the goal is to manage for successful forest regeneration within the park, not for deer density, the results of removal would be documented annually, so that the number of deer to be removed could be adjusted based on the response of the vegetation to a higher or lower deer density. If vegetation were observed to be regenerating before the lower deer density was reached, management actions could then be modified or adjusted. Similarly, management actions would be adjusted if no change in the vegetation were observed after implementation. It is noted that deer densities in the park may drop based on actions of other entities that are removing deer within park boundaries on their properties. If deer density goals were reached in some areas of the park, then adaptive management would consist of moving into maintenance actions as long as the forest regeneration (vegetation) monitoring supports this. The following are examples of how an adaptive management approach could be implemented based on different outcomes:

- If forest regeneration occurred prior to meeting the initial deer density goal, the deer density goal would be adjusted upward to the density that would still allow regeneration to occur, or different goals could be assigned to different zones of the park depending on vegetation monitoring results.
- If insufficient forest regeneration occurred within 10 years after the initial deer density goal was reached, then methods and protocols would be reviewed to identify the variables that were limiting expected results, and the methods used would be adjusted as necessary to correct for such factors. The goal would not be adjusted by any more than 5 additional deer per square mile until after a 6-year monitoring period, at which point the density goal could be adjusted further.
- If the initial deer density goal of 15 to 30 deer per square mile were not reached within 4 years in all zones of the park, additional efforts would be made to reach the desired density through the use of other methods of removal or by concentrating efforts more in one area and coordinating with entities outside the park that are removing deer near that area.

Deer Exclosures

Large (23-acre) exclosures are proposed under Alternative B. As some areas are exclosed, deer browsing pressure in other areas could increase, making additional exclosures necessary in those areas. Thus, over the course of management actions, the investment in materials and maintenance could increase. Areas inside and outside the proposed large exclosures would be monitored according to the protocol described for Alternative A. If vegetation damage due to deer browsing increased significantly in unfenced areas, additional exclosures would be considered. Rotation schedules could be adjusted based on monitoring and regeneration results.

Nonsurgical Reproductive Control

Reproductive control is proposed under Alternatives B and D. However, there is limited information regarding its effectiveness as a long-term management tool for large, free-ranging populations. As science advances in this area, additional agents could be developed and tested for reproductive control on free-ranging deer, or more efficient delivery methods could be approved. The park would review the science at that time to determine if an agent were appropriate for controlling the deer herd. The size, scale, and location of the application would depend on the specifications and efficacy of the drug.

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 park, existing technology, and knowledge of deer population dynamics and CWD. During the life of the plan, it is assumed that knowledge and experience with these issues will increase. Improved knowledge and experience may result in adjustments being made to the timing of actions (e.g., timing of lethal reduction, implementation of reproductive control, CWD surveillance, or any of the other elements included in the plan/EIS.) For example, Alternative D (combined lethal and nonlethal actions) would be adjusted for each individual action as required to maximize forest regeneration. These actions could also be adjusted to stay current with new technologies or research. The initial plan would be to focus on direct reduction to decrease deer population density as quickly as possible, to minimize the number of deer to be removed over time, and to test action thresholds within a reasonable time frame. After deer density was reduced to the initial goal, and if vegetation monitoring indicated that vegetation was regenerating, maintenance of deer numbers might be achieved through reproductive control, depending on the state of the technology and as noted in the adaptive management parameters described above.

2.9 SUMMARY OF ALTERNATIVES AND HOW THEY MEET THE PLAN OBJECTIVES

Table 2-10 compares the alternatives by summarizing the elements being considered within each alternative, and Table 2-11 compares how each of the alternatives described in this chapter would meet the plan objectives. The action alternatives analyzed must meet the objectives to a large degree, as stated in “Chapter 1: Purpose of and Need for Action,” and they must 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 stated in “Section 1.2.3, Objectives in Taking Action.” Alternatives that did not meet the objectives were not analyzed further (see “Section 2.10, Alternatives Considered but Dismissed from Detailed Analysis”).

The environmental analysis described in “Chapter 4: Environmental Consequences” looks at the effects of each alternative on each impact topic; these impacts are summarized in Table 2-12.

TABLE 2-10: SUMMARY OF ALTERNATIVES

	Alternative A: No Action	Alternative B: Combined Nonlethal Actions	Alternative C: Lethal Actions	Alternative D: Combined Lethal and Nonlethal Actions
Management actions	Continue deer monitoring, vegetation monitoring, protection of restoration plantings, data management and research, herd health checks, education, and coordination with other agencies.	All actions under Alternative A, plus: • Construct up to 30 large-scale fenced exclosures for the purposes of forest regeneration. • Implement reproductive control of does if an acceptable reproductive control agent that meets the stated criteria is available. • Monitor large-scale deer exclosures and monitoring sites, the effectiveness of deer reproductive control, and CWD.	All actions under Alternative A, plus: • Use direct reduction methods (sharpshooting or capture/ euthanasia where sharpshooting would not be advisable) to reduce deer herd numbers. • Focus on areas of the park documented to have substantial browsing impacts. • Donate meat, if possible.	All actions under Alternative A, plus techniques described under Alternatives B and C. • Use direct reduction methods (sharpshooting or capture/ euthanasia where sharpshooting not advisable) to reduce deer herd numbers. • Apply reproductive control to treat the maximum number of does and later to maintain population size, with direct reduction used as a back-up method, if needed. • Donate meat, if possible.
Reduction in deer population	None, other than natural sources of mortality and potential reductions from actions taken outside of NPS lands.	Potentially reduce deer population if reproductive controls are successful and then only after the first several years of treatment or until natural mortality exceeded reproduction and reduced the population; could meet the population goal gradually, but the risk of not meeting the goal is relatively high.	Remove 375 deer annually for 4 years to achieve the midpoint of the target density level of 15–30 deer/sq. mi. To maintain target level after year 5, remove 175 deer annually, depending on the density.	Initially similar to Alternative C. Potential for future reductions through reproductive control used as a population maintenance tool or direct reduction as needed to maintain the desired density.

	Alternative A: No Action	Alternative B: Combined Nonlethal Actions	Alternative C: Lethal Actions	Alternative D: Combined Lethal and Nonlethal Actions
Time required to achieve desired forest regeneration	Forest regeneration cannot be achieved without reducing browsing impacts.	Regeneration of woody vegetation would occur in 5% to 10% of the park over the life of the plan (15 years), and herbaceous regeneration would occur within a maximum of 5% of the park at any one time over the life of the plan, given large-scale exclosures. Reproductive control would contribute to additional forest regeneration by gradually limiting deer numbers, but desired deer density and subsequent forest regeneration would likely not be achieved within life of this plan.	Reduced deer population by year 4, with regeneration changes observed in monitoring by year 14, and trends toward regeneration success by end of plan.	Same as Alternative C.
Handling of deer	None.	Capture would be required to use current registered formulation of GonaCon™ and initially for any agent used to enable marking of deer. Handling would be minimized as much as possible to reduce stress in accordance with the AVMA recommendations. Potential increased stress levels in captured deer.	No capture required for sharpshooting activities. For capture and euthanasia, minimized handling to reduce stress in accordance with the AVMA recommendations. Potential increased stress levels in captured deer compared to sharpshooting.	Same as Alternative B for reproductive control and Alternative C for sharpshooting.
Monitoring	Continued vegetation monitoring and monitoring of deer population levels to assess impacts.	Continue monitoring as described under Alternative A, plus additional vegetation plots for action threshold detection and large deer exclosures for forest regeneration. For reproductive control, monitoring of treated deer using additional fawn surveys to determine reproductive control effectiveness.	Continue monitoring vegetation as under Alternative A, plus additional vegetation plots for action threshold detection throughout deer removal efforts. Monitor deer to assess success of previous removal efforts and adjust numbers of future reductions.	Same as Alternatives B and C.

	Alternative A: No Action	Alternative B: Combined Nonlethal Actions	Alternative C: Lethal Actions	Alternative D: Combined Lethal and Nonlethal Actions
CWD surveillance and testing	None.	Opportunistic surveillance initiated. If CWD case were confirmed within 60 miles of park, targeted surveillance would be initiated.	Same as Alternative B but greater opportunistic surveillance and testing given reduction efforts and potential meat donation.	Same as Alternative C but with fewer opportunities for opportunistic surveillance after year 4.
Donation for consumption or disposal of carcasses	Carcasses (e.g., from deer/vehicle incidents) are currently disposed of via landfill or surface disposal as appropriate.	The selected reproductive control agent should have no restrictions on donation for consumption (e.g., GonaCon™ has no such restrictions).	Donation of meat for consumption would be to the maximum extent possible pending CWD testing results. Meat not suitable for donation would be surface disposed (if few individuals) or disposed of in a landfill. If known CWD case were confirmed within 60 miles of the park, disposal would be per alkaline digestion, incineration, or landfill per NPS, state, and local requirements.	Same as Alternatives B and C.
Regulatory considerations	No specific regulatory requirements.	Must follow all label restrictions including hand injection, use of qualified personnel, personal protection requirements, limiting access to area, and precautions for women/children. EPA approval is required for agents. Additional requirements could be prescribed by NPS (e.g., marking). Must follow NPS, state, and local public health guidelines for CWD.	Necessary ATF permits would be obtained. Coordination with state/local/nonprofit/private entities might be needed to donate meat. Follow NPS, state, and local public health guidelines for CWD.	Same as Alternatives B and C.
Park closure or restricted access	None related to deer or vegetation monitoring activities.	Restricted access within exclosures and in areas of active reproductive control activities (mainly October through March).	Areas closed or access restricted during direct reduction activities; closures or restrictions minimized by conducting activities during fall and winter if possible.	Areas closed or access restricted during direct reduction and reproductive control activities; closures or restrictions minimized by conducting activities during fall and winter.

	Alternative A: No Action	Alternative B: Combined Nonlethal Actions	Alternative C: Lethal Actions	Alternative D: Combined Lethal and Nonlethal Actions
Adaptive management	No specific adaptive management included under this alternative.	Potential changes in action thresholds or deer density goals, relocation of vegetation monitoring plots, possible changes in reproductive control agent used and its application procedures.	Same as Alternative B.	Same as Alternative B; lethal and nonlethal actions would be adjusted as required to maximize forest regeneration and stay current with technologies. This would include determining whether sharpshooting or reproductive control would be used for reductions and population maintenance.
Estimated cost (15-year plan)	$750,930	$7,942,903	$2,369,788	$4,201,113

TABLE 2-11: ANALYSIS OF HOW THE ALTERNATIVES MEET PLAN OBJECTIVES

Objective	Alternative A: No Action	Alternative B: Combined Nonlethal Actions	Alternative C: Lethal Actions	Alternative D: Combined Lethal and Nonlethal Actions
Management Methodology				
Develop and implement informed, scientifically defensible vegetation and wildlife impact levels and corresponding measures of deer population size that would serve as thresholds for taking adaptive management actions within the park.	**Does not** meet objective. Deer density goals and action thresholds for vegetation would not be established.	**Fully** meets objective. Thresholds for taking action have been identified by the science team and incorporated into science-based impact levels and an adaptive management approach to management of deer populations.	**Fully** meets objective; same as Alternative B.	**Fully** meets objective; same as Alternative B.
Wildlife and Wildlife Habitat				
Reduce adverse effects of deer behavior, including browsing, trampling, and seed dispersal, on the natural abundance, distribution, and diversity of native wildlife species within the park.	**Does not** meet objective. Continued browsing pressure could prohibit the lower canopy from naturally regenerating, reducing the amount of native wildlife habitat (including ground-nesting bird habitat) within the park.	**Partially** meets objective because only fenced areas would be protected and these fenced areas would only cover a limited portion of the park at a given time.	**Fully** meets objective. A reduction in the deer herd size would allow forest regeneration, resulting in a regeneration of the lower forest canopy, which would restore native wildlife habitat, including ground-nesting bird habitat, within the park.	**Fully** meets objective; same as Alternative C.
Protect habitat of wildlife species of concern, including rare, threatened, or endangered species, from adverse impacts related to deer behavior, including browsing, trampling, and seed dispersal.	**Does not** meet objective. Protection of habitat of sensitive and rare species would not occur except for limited small-scale exclosures. Continued browsing pressure given the lack of management actions to control the deer population could result in adverse impacts on these species.	**Partially** meets objective. Habitat of sensitive and rare species would only be protected in fenced areas and these fenced areas would only cover a limited portion of the park at a given time. Browsing impacts would only be gradually reduced in unfenced areas.	**Fully** meets objective. Protection of habitat of sensitive and rare species would occur quickly with a reduction in the deer herd size.	**Fully** meets objective; same as Alternative C.

Objective	Alternative A: No Action	Alternative B: Combined Nonlethal Actions	Alternative C: Lethal Actions	Alternative D: Combined Lethal and Nonlethal Actions
Maintain a viable white-tailed deer population within the park while protecting other park resources (see definition of "viable" in Chapter 1).	**Does not** meet objective. The deer population would not be in balance with the forest ecosystem and the health of the herd would be compromised. Other park resources would continue to be impacted by deer browsing.	**Partially** meets objective. Other park resources would only be protected in fenced areas and these fenced areas would only cover a limited portion of the park at a given time. Browsing impacts on other resources would only be gradually reduced in unfenced areas.	**Fully** meets objective. A viable deer population would be achieved and other park resources would be protected as a result of reducing the herd size and thus reducing browsing impacts.	**Fully** meets objective; same as Alternative C.
Vegetation				
Reduce adverse effects of deer behavior, including browsing, trampling, and seed dispersal, on the natural abundance, distribution, and diversity of native plant species.	**Does not** meet objective. No reduction in deer browsing pressure. Adverse impacts on native plant species would continue to occur, based on monitoring results to date.	**Partially** meets objective in fenced areas; these fenced areas would only cover a limited portion of the park at a given time. Browsing impacts on other resources would only be gradually reduced in unfenced areas.	**Fully** meets objective. A reduction in the deer herd size would allow forest regeneration, resulting in a mix of native herbaceous plant species.	**Fully** meets objective; same as Alternative C.
Protect native plant species of concern, including rare, threatened, or endangered species, from adverse impacts related to deer behavior, including browsing, trampling, and seed dispersal.	**Partially** meets objective. Small fences would protect some sensitive plant species in limited locations.	**Partially** meets objective. Protection would be provided in fenced areas; however, these fenced areas would only cover a limited portion of the park at a given time. Browsing impacts on other resources would only be gradually reduced in unfenced areas.	**Fully** meets objective. Protection of vegetation, sensitive plant populations, and rare plant species would occur with an immediate reduction in the deer herd.	**Fully** meets objective; same as Alternative C.
Reduce adverse effects of deer behavior, including browsing, trampling, and seed dispersal, on native plant species through dispersal, spread, and facilitation of exotic, invasive species.	**Does not** meet objective. Overbrowsing would continue to contribute to the spread of invasive species.	**Partially** meets objective in fenced areas. Overbrowsing outside fenced areas would continue to contribute to the spread of invasive species.	**Fully** meets objective. A reduction in the deer herd size would reduce the adverse effects of deer. Overbrowsing would not contribute to the spread of invasive species.	**Fully** meets objective; same as Alternative C.

Objective	Alternative A: No Action	Alternative B: Combined Nonlethal Actions	Alternative C: Lethal Actions	Alternative D: Combined Lethal and Nonlethal Actions
Cultural Resources				
Protect the integrity, variety, and character of the rural landscape by minimizing the effects of deer behavior on the rural landscape.	**Does not** meet objective. No overall protection for the park's rural landscapes; only minimal protection of elements of the landscape through small-scale fencing or tubing.	**Partially** meets objective. Protection of vegetation within exclosures but limited protection for the park's rural landscapes given only gradual reduction of deer herd size and browsing impacts. Some visual impacts from large-scale fences.	**Fully** meets objective. Vegetation regeneration and reduced browsing impacts more immediate with a quick reduction in deer herd.	**Fully** meets objective; same as Alternative C.
Visitor Experience				
Enhance public awareness and understanding of NPS resource management issues, policies, and mandates, especially as they pertain to deer management.	**Fully** meets objective. Continued education and coordination would occur under Alternative A.	**Fully** meets objective. Continued education and coordination would occur. Greater opportunity would exist regarding education and coordination on deer management activities, including CWD issues and regeneration of native species.	**Fully** meets objective; same as Alternative B.	**Fully** meets objective; same as Alternative B.
Ensure that visitors have the opportunity to view deer in the natural environment at population levels that do not adversely impact visitors' enjoyment of other native species in the natural landscape.	**Does not** meet objective. Deer population levels would adversely impact the natural landscapes and subsequent visitor enjoyment.	**Partially** meets objective. Fencing could lead to visual impacts on visitors. Some disruption to visitors from implementing reproductive controls if access needs to be limited during higher visitation periods. Visitors may be disturbed by artificial markings on deer.	**Fully** meets objective with mitigation. Disruption of visitor experience would be minimized if sharpshooting occurred at night with noise suppression and during times and periods when visitation is low (late fall and winter months).	**Partially** meets objective. Some disruption to visitors from implementing reproductive controls if access needs to be limited during higher visitation periods. Visitors may be disturbed by artificial markings on deer.

TABLE 2-12: SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: No Action	Alternative B: Combined Nonlethal Actions	Alternative C: Lethal Actions	Alternative D: Combined Lethal and Nonlethal Actions
Vegetation	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Moderate to major adverse impacts because browsing pressure would be expected to remain high in either all or a large portion of the park throughout the life of this plan.	Moderate to major adverse impacts because reproductive control would result in only a gradual reduction in the deer population, and the exclosures would protect only a small portion of the forest at any one time, requiring 10 years for regrowth above the browse line; short-term negligible impacts from deer management actions(e.g., bait pile placement, trampling).	Long-term and beneficial because the relatively rapid deer herd reduction would allow the abundance and diversity of vegetation throughout the park to recover and better protect special-status plants; short-term negligible impacts from deer management actions.	Same as Alternative C.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term, moderate, and adverse.	Long-term, moderate, and adverse.	Long-term beneficial.	Long-term beneficial.
White-tailed Deer	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Long-term, minor to moderate, adverse because browsing pressure would likely remain high in either all or a major portion of the park throughout the life of this plan; short-term negligible impacts from monitoring activities; also long term moderate adverse impacts potentially from CWD (increased potential for spread with high deer density).	Long-term minor to moderate adverse impacts, mainly because reproductive control would result in a gradual reduction in the deer population and the exclosures would protect only a small portion of the forest at any one time, requiring 10 years for regrowth above the browse line; short-term negligible to minor impacts from deer management actions (bait piles, noise and disturbance); and long term minor to moderate adverse impacts potentially from CWD (increased potential for spread with high deer density).	Long-term and beneficial because the relatively rapid deer herd reduction would allow the abundance and diversity of vegetation throughout the park to recover and better protect deer habitat; long-term minor adverse effects potentially from CWD (likelihood of spread) and short-term negligible adverse effects from implementing deer management actions (noise, disturbance).	Same as Alternative C.

Impact Topic	Alternative A: No Action	Alternative B: Combined Nonlethal Actions	Alternative C: Lethal Actions	Alternative D: Combined Lethal and Nonlethal Actions
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term, minor to moderate adverse.	Long-term, minor to moderate adverse.	Long-term beneficial.	Long-term beneficial.
Other Wildlife and Wildlife Habitat	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Long-term, and negligible to potentially major adverse, depending on the species. Species that depend on ground cover and young tree seedlings or understory shrubs for food or cover could be severely reduced or eliminated from the park, while impacts on species that depend primarily on other habitats (not woodlands) or on the upper canopy for food and cover would be negligible.	Same as Alternative A.	Mostly beneficial and long term; the long-term reduction and controls on deer population growth would allow vegetation used as food and cover for other wildlife to become more abundant, especially in zones that have deer densities far in excess of the desired level. There could be long-term minor adverse effects to some species and short-term negligible adverse impacts from disturbance during the implementation of the action.	Same as Alternative C.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term moderate adverse.	Same as Alternative A.	Long-term beneficial.	Long-term beneficial.
Special-status Species	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Adverse, long-term, and negligible to potentially major, depending on the species.	Same as Alternative A.	Mostly beneficial and long-term, depending on the species, with long-term minor adverse effects to some species that prefer open habitat and short-term negligible adverse impacts from disturbance during the implementation of the action.	Same as Alternative C.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Adverse, long-term, and minor to potentially major cumulative impacts, depending on the species.	Same as Alternative A.	Long-term beneficial.	Long-term beneficial.

Impact Topic	Alternative A: No Action	Alternative B: Combined Nonlethal Actions	Alternative C: Lethal Actions	Alternative D: Combined Lethal and Nonlethal Actions
Rural Landscapes	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Long-term, moderate, adverse due to the continued high levels of the deer population and the associated ongoing depredation of plantings and crops by deer in unfenced rural landscape areas.	Long-term, moderate adverse because, in the majority of the park not fenced, agricultural crops and other vegetation would continue to be adversely affected by deer browsing until reproductive controls became effective and the population decreased; in addition, the presence of exclosures would result in long-term minor adverse impacts to the cultural landscapes in which they are located.	Short-term negligible adverse but mostly long-term beneficial impacts due to decreased browsing and thus decreased deer depredations of agricultural crops, which would lead to increased chances of viability for the park's farm ventures and maintain the open and closed patterns of the rural landscape.	Same as Alternative C.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term minor to moderate adverse.	Long-term moderate adverse.	Long-term beneficial.	Long-term beneficial.
Socioeconomic Resources/Adjacent Lands	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Long-term, minor to moderate, adverse because of the continued high density of deer expected over the life of this plan and the associated costs of landscape damage, crop loss, and additional costs for fencing, repellents, and other forms of deer control to protect landscaping, as well as protection of livestock from disease.	Long-term moderate adverse impacts for the same reasons as Alternative A, but with the additional impact of precluding deer from the large exclosures, which could add to browsing pressure on surrounding lands.	Long-term and beneficial because the relatively rapid reduction in deer density would reduce adverse impacts to landowners, due to improved crop yields and preserved landscaping and reduce the need for landscape, crop and livestock protection.	Same as Alternative C.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term minor to moderate adverse.	Long-term moderate adverse.	Long-term beneficial.	Long-term beneficial.

Impact Topic	Alternative A: No Action	Alternative B: Combined Nonlethal Actions	Alternative C: Lethal Actions	Alternative D: Combined Lethal and Nonlethal Actions
Visitor Use and Experience	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Both beneficial and adverse to those visitors who maybe primarily interested in viewing deer (beneficial in that there would be more deer to see, adverse in that the appearance of the herd could be poor). However, overall impacts related to a decreased ability to view scenery (including native vegetation and the rural landscape) and other wildlife, which is important to many visitors using the park, would be long term, minor to moderate, adverse.	Both beneficial and adverse to those visitors, similar to Alternative A, since deer would still be present in relatively high numbers for a long time. Adverse impacts to visitor use and experience from the presence of exclosures and the continued effects of deer overbrowsing would range from negligible to moderate, and impacts related to forest regeneration would gradually become beneficial in the long term, beyond the life of this plan. Visitors may see various aspects of the reproductive control operations, which could result in minor adverse impacts to their visitor experience.	Would vary between users; impacts would be short and long-term, moderate to major adverse to those opposed to lethal deer management within the park and minor adverse effects during implementation from disturbance, but long-term and beneficial to those who value an increase in vegetative and wildlife diversity and being able to view natural and rural landscapes unaffected by overbrowsing.	Same as Alternative C.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term negligible adverse.	Long-term beneficial.	Long-term negligible adverse.	Long-term negligible adverse.
Visitor, Employee, and Volunteer Health and Safety	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Long-term, adverse and range from negligible to potentially major depending on the source and outcome of accident.	Same as Alternative A.	Long-term, negligible to minor adverse with long-term beneficial impacts in several areas of risk due to the reduction in deer density.	Same as Alternative C.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term, moderate, adverse.	Same as Alternative A.	Long-term negligible adverse.	Same as Alternative C.

Impact Topic	Alternative A: No Action	Alternative B: Combined Nonlethal Actions	Alternative C: Lethal Actions	Alternative D: Combined Lethal and Nonlethal Actions
Park Management and Operations	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Long-term, negligible to minor adverse; because present deer management actions would continue, the park's deer population is expected to continue to fluctuate and remain at high levels, resulting in long-term demands on park staff and funding for managing the deer herd and protecting other park resources.	Long-term, moderate to potentially major adverse impacts on park management and operations from installing and maintaining large exclosures, and implementing and monitoring reproductive controls, with minor adverse impacts from increased educational/interpretive activities and CWD surveillance.	Moderate adverse impacts during the period of direct reduction efforts because of the need for additional staff time for monitoring and coordinating activities. The use of qualified federal employees or authorized agents would reduce the amount of park staff time needed for implementation, but would still result in costs. With the greater reduction of deer over a shorter period of time, park staff would have more time to apply their efforts to other areas of the park when compared to Alternative A, which would reduce adverse, long-term impacts from moderate to minor over time, with long-term minor adverse impacts from increased educational/interpretive activities and CWD surveillance.	Moderate adverse impacts, as park staff involvement would be required for coordination and monitoring of the reduction and reproductive control actions. Once the deer herd was reduced, more staff time would be available for other activities, resulting in long-term, minor adverse impacts, with long-term minor adverse impacts from increased educational/interpretive activities and CWD surveillance.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term minor adverse.	Long-term moderate to major adverse.	Long-term moderate adverse.	Long-term moderate adverse.

2.10 ALTERNATIVES CONSIDERED BUT DISMISSED FROM DETAILED ANALYSIS

The following alternatives were considered but dismissed from detailed analysis for reasons explained below.

2.10.1 MANAGED HUNT/PUBLIC HUNTING

Throughout the years, the NPS has taken differing approaches to wildlife management, but has maintained a strict policy of not allowing hunting in park units of the national park system where it is not congressionally authorized. In 1970, Congress passed the General Authorities Act and in 1978 the "Redwood Amendment," which clarified and reiterated that the single purpose of the NPS Organic Act is conservation. While the Organic Act gives the Secretary of the Interior the authority to destroy plants or animals for the purposes of preventing detriment to park resources, it does not give the Secretary authority to permit the destruction of animals for recreational purposes. In 1984, after careful consideration of congressional intent with respect to hunting in national parks, the NPS promulgated a rule that allows public hunting in national park areas only where "specifically mandated by Federal statutory law" (36 CFR 2.2). The NPS reaffirmed this approach in the NPS *Management Policies 2006* (NPS 2006b).

Public hunting is inconsistent with existing laws, policies, and regulations for Cuyahoga Valley National Park and all other units of the national park system where hunting is not authorized. Changing these long-standing service-wide policies and regulations regarding hunting in parks is beyond the scope of this plan/EIS and inconsistent with the purposes of this park. Therefore, public hunting was considered but not carried forward for analysis.

2.10.2 PREDATOR REINTRODUCTION

Relationships between predators and prey are complex, and the impact of predators on herbivore populations is variable (McCullough 1979). Coyotes, bears, and bobcats are potential deer predators that reside throughout much of North America, including the Cuyahoga Valley area (coyotes). However, these species appear to be opportunists that take advantage of specific periods of deer vulnerability, and none of these predators has demonstrated a consistent ability to control deer populations. Coyote populations in the Cuyahoga Valley region are being studied by MPSSC in cooperation with several other agencies including the NPS (MPSSC 2011b). Preliminary results of coyote diet through scat analysis demonstrate a varied diet (including deer) with seasonal trends and indicate that deer remains were present in about 38 percent of scat samples analyzed. Even though coyote populations have increased and coyotes' range has expanded in the past 20 years, both deer and coyote populations have increased simultaneously in many areas. 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.

Wolves and mountain lions are efficient deer predators, but they have been eliminated from much of the United States. Reintroducing these predators into Cuyahoga Valley National Park would not be feasible due to a lack of suitable habitat. Wolves have home ranges averaging 30 square miles when deer are the primary prey (Mech 1991), which is about the size of Cuyahoga Valley National Park. However, most of the park area is surrounded by and includes an urban or suburban environment, making it impractical for such predators to be reintroduced. Other native animals, as well as domestic pets and livestock, could also become potential prey if predators were reintroduced to the Cuyahoga Valley area.

For the reasons described above relating to effectiveness, habitat limitations, and human safety concerns, reintroduction of predators was dismissed as a reasonable alternative.

2.10.3 USE OF POISON

Under this alternative, poison would be mixed with food sources such as grains to kill deer. Death from poisoning is often considered inhumane (University of Vermont [UVM] 1997). Death is not immediate, and health concerns resulting from people potentially hunting and eating poisoned deer that have wandered out of the park could be an issue. Currently no toxicants, poisons, or lethal baits are registered for deer control. In addition, nontarget native wildlife or roaming pets could potentially eat a tainted carcass or the poison itself (Bishop et al. 1999). Therefore, this alternative was dismissed.

2.10.4 CAPTURE AND RELOCATION

Capturing deer within Cuyahoga Valley National Park and relocating them would be in violation of NPS policy regarding translocation (NPS 2002f). Even if the policy were not in effect, permits would be required to relocate deer to areas a sufficient distance from the park to ensure that they would not return. Given the abundance of deer in Ohio and most of the United States, areas for relocation would be very limited. Also, live capture and relocation methods can result in high mortality rates among captured and/or relocated deer. Implementation of this alternative could result in the death of more than 50 percent of the deer during the first year after release (Jones and Witham 1990). In one study only 15 percent of the relocated deer survived 1 year after relocation (O'Bryan and McCullough 1985). In addition, due to potential concerns related to CWD, it is possible that quarantine processes would be required. Due to the concerns discussed above relating to policy, costs, feasibility, and high mortality, capture and release was dismissed as a reasonable alternative.

2.10.5 SUPPLEMENTAL FEEDING

Providing supplemental food to deer is often suggested as a way of reducing damage to natural or ornamental vegetation. Although providing alternative food sources could provide temporary relief from browsing to plants needing protection, it would not provide a long-term solution. Supplemental feeding would increase survivability and reproduction in the deer population, thus compounding problems that already exist. It encourages increased deer population growth and negative impacts on habitat and other wildlife, as well as greater deer/human conflict (NDTC 2009), and is therefore in conflict with the goals of this plan. In addition, the NPS *Management Policies 2006*, Section 4.4.1, "General Principles for Managing Biological Resources," and 4.4.2, "Management of Native Plants and Animals," are aimed at allowing natural processes to occur whenever possible (NPS 2006a). For these reasons, this alternative was dismissed.

2.10.6 FENCING THE ENTIRE PARK

Fencing the entire park would effectively prevent deer from entering or leaving the park given the number of potential entry points (e.g., roads, driveways) and fragmentation of the park. Fences approximately 8 feet high would be needed to prevent deer from jumping over the barriers. Even if the entire park were fenced, vegetation within Cuyahoga Valley National Park would continue to suffer the effects of deer browsing because the deer population within the fenced area would continue to increase and the health of the contained herd would suffer. Therefore, either all deer within the fenced area would need to be removed or the deer population within the fence would need to be managed with other methods to meet the objectives of the management plan. For these reasons, this alternative was dismissed.

2.10.7 REPELLENTS

Deer repellent products are generally either odor-based or taste-based. Odor-based repellents incorporate a smell that is supposed to be offensive to deer, such as human hair, soap, garlic, rotten eggs, blood meal, or seaweed. Taste-based repellents incorporate a taste that is offensive to deer, such as hot pepper juice. Repellents protect vegetation by reducing the attractiveness and palatability of treated plants to a level lower than that of other available forage. Repellents are more effective on less palatable plant species than on highly preferred species (Swihart and Conover 1990). Repellent performance seems to be negatively correlated with deer density, meaning that the higher the abundance of deer, the less likely the repellent would be effective. Success with repellents is measured as a reduction in damage; total elimination of damage should not be expected (Craven and Hygnstrom 1994).

Deer repellents are not currently used in Cuyahoga Valley National Park. Large-scale application of repellents is not practical due to the need for frequent applications, resulting in high application cost; label restrictions on use; and variable effectiveness. Repeated applications of spray repellents would be necessary due to weather and emergence of new growth. Many commercial repellents indicate that they persist after normal rain events, with varying persistence of 1 to 6 months. Both taste-based and odor-based repellents can have a short residence time when applied to plant material and must be monitored and applied frequently to retain their effectiveness.

Because the effectiveness of repellents is variable and is least effective with high deer densities and because of the size of the areas that would require treatment (greater than 14,000 acres), repellent use within the park as a management alternative was dismissed.

2.10.8 LANDSCAPE MODIFICATION THROUGH FENCING

During internal scoping, landscape modification or habitat management was suggested as a potential alternative. Deer are attracted to highly fragmented habitat; therefore, reducing fragmentation would possibly lead to less desirable forested habitat. Deer populations in a forested habitat could not be sustained at levels currently supported by the food resources available in the fragmented landscape. Over time, the deer population would decline because of lower food availability. This alternative would involve modifying the entire park landscape to reduce fragmentation of forests by fencing or restoring old field areas in strategic locations to allow forest succession to occur. This approach would reduce the total acreage of unforested land and create larger blocks of contiguous forest to manipulate deer feeding behavior and movements. It would also include changing agricultural practices within the park to either reduce total acreage or change the types of crops planted to types that are less palatable to deer, thereby reducing food availability for deer across the landscape of the park.

This alternative was dismissed from further analysis because white-tailed deer are very adaptable animals, adjusting their diets to use available food sources. Even if fragmentation could be reduced, deer numbers would decline so slowly that browsing damage to existing forests would still occur and would likely even increase in certain areas. Furthermore, the degree to which fragmentation can be reduced within this park is limited by other factors such as roads and private land uses. Therefore, trying to manage a deer population by managing the habitat to manipulate deer feeding behavior and movements in a highly fragmented environment surrounded by agricultural and suburban land uses would be extremely complex, inefficient, and likely unsuccessful.

One of the park’s missions is to protect the rural areas within the park under the Countryside Initiative Program, which is managing park lands for a rural, agricultural landscape (cropland and small farm operations). The objective of this program is to rehabilitate and revitalize farms within the park, and the landscape modification alternative would be inconsistent with this objective. The Countryside Initiative

Program allows fencing of all agricultural fields within the park on leased lands to protect against deer, and fencing is being implemented on many of the leased farmlands under this program. As these food sources are fenced and removed from deer over time, browsing pressure on the forests will most likely increase.

In addition, landscape modification actions to reduce deer density could also negatively impact other wildlife. This alternative was not carried forward for analysis since it would not meet the objectives of the plan/EIS. It did not address the current deer damage to vegetation and other resources due to browsing in areas that would not be fenced.

2.10.9 REPRODUCTIVE CONTROL (AS A STAND-ALONE ALTERNATIVE)

Reproductive Control of Does

Reproductive control options to restrict the growth of the deer population were considered and were incorporated into Alternatives B and D. However, reproductive control as a stand-alone alternative was dismissed because it would not meet the objectives of the plan in a timely manner, due to the length of time reproductive control by itself would take to reduce the deer population. The following reproductive control methods were not considered for further analysis for the reasons described below.

Surgical Sterilization

This alternative would initially implement a phased approach to surgically sterilizing does within the park in an effort to halt reproduction and potentially reduce the size of the population over a number of years through natural mortality. Even though both sexes can be treated, surgical sterilization of females is more effective for population control in polygamous species like white-tailed deer. In addition, males are generally more difficult to capture because they are more wary and less gregarious than does. Sterilization of does is an invasive procedure, requiring either the surgical removal of ovaries or tubal ligation. Procedures require full anesthesia and must be conducted by a veterinarian. It is possible to conduct the surgery in the field. However, complications could result due to a relatively high incidence of infection. If field surgery is required, a temporary or mobile field station could be set up to minimize the potential for infection and reduce impacts on visitors. A mortality rate of 15 to 20 percent is possible with field surgery. Because surgical sterilization is permanent, the animal would be handled only once.

Surgical sterilization has several downsides: treating a number of deer on a large scale is difficult; success is unlikely if deer are moving in and out of the park (Merrill, Cooch, and Curtis 2006); and the procedure is labor-intensive, taking approximately 6 to 8 hours per deer to capture, transport, treat, and return to release. Even though this treatment is permanent for individuals, annual sweeps would be needed to treat new deer recruited into the area.

This alternative would have the advantage of permanently sterilizing individual does. Does would be captured, tagged, surgically sterilized, and then released back into the park. In addition to the stress of the capture, individual animals would also be stressed by tranquilizers/anesthesia, surgical procedures, and recovery, which could increase mortality rates of sterilized individuals. Additionally, the long-term effects of this alternative on population genetics or behavior have not been well documented. Some researchers suggest that, depending on the type of sterilization used, changes in animal behavior would be expected (Warren and Warnell 2000). Removal of the ovaries, thus changing hormone production in the treated animal, would result in altered behavior. With a ligation procedure, normal hormone production would remain; however, this has been shown to result in repeated estrous cycles during the breeding season (Knox, Miller, and Marchinton 1988), extending the rut by modifying the male response behavior.

Due to the high numbers of deer needing treatment and the amount of labor required to manage does by surgical sterilization, this issue was considered and dismissed because of concerns about feasibility, stress to the animals, and long-term effects on population genetics and behavior.

Contragestives

A contragestive is a drug that is applied after a doe becomes pregnant and that terminates the pregnancy. This method would need to be administered annually. Contragestive agents differ in two ways from contraceptive control methods: the time of application (during pregnancy rather than before) and the potential harm to the deer. If the drug is administered too late in the pregnancy, it could make the delivery of a dead fetus difficult, potentially harming the doe. However, if the contragestive is applied too early, the doe could become pregnant again. Efficacy is approximately 75 to 80 percent, depending on timing. This method could be used to supplement the effectiveness of contraceptives, essentially treating animals missed with contraceptive treatments or those for which the treatment was not effective. The difficulty would then become how to determine which deer are pregnant. This would require either significant monitoring/observation of the deer, or recapturing does to check for pregnancy.

Given the number of deer in the area and the size of the park, large-scale implementation of contragestives would not be feasible due to the amount of staff time and monitoring required to make it effective. Even on a limited scale, the use of other reproductive control measures would provide greater efficacy and efficiency than contragestives. In addition, contragestives may be considered inhumane because of their mode of action, and their potential to harm the doe. Therefore, the park dismissed the use of contragestives as a reproductive control option.

Reproductive Control of Bucks

Another form of reproductive control includes sterilization of bucks. In a study of sterilization of feral horses, sterilizing only dominant harem stallions resulted in relatively modest reductions in population growth. Substantial reproduction may occur even when 100 percent of the dominant harem stallions are sterilized if other males perform as little as 10 percent of the breeding. Adequate suppression of population growth may be attained only if a large proportion of all males in the population are sterilized (Garrott and Siniff 1992).

Under this alternative, long-term population stability would become an issue along with genetic variability (a few nondominant bucks could breed the entire herd). If females did not become pregnant, their estrous cycle could be extended, resulting in later pregnancies and lower survival for fawns born later in the year (as a result of a higher winterkill potential). The population dynamic and makeup of the herd could suffer under this alternative. Because of the concerns relating to effectiveness, population stability, and genetic variability, this alternative was dismissed from detailed analysis.

2.11 CONSISTENCY WITH THE PURPOSES OF THE NATIONAL ENVIRONMENTAL POLICY ACT

NEPA requires an analysis of how each alternative meets or achieves the purposes of the act (Section 101[b]). Each alternative analyzed in a NEPA document must be assessed as to how it meets the following purposes:

(1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

(2) assure 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 will permit high standards of living and a wide sharing of life's amenities; and

(6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources (42 USC 4331).

The CEQ has promulgated regulations for federal agencies' implementation of NEPA (40 CFR 1500–1508). Section 1500.2 states that federal agencies shall, to the fullest extent possible, interpret and administer the policies, regulations, and public laws of the United States in accordance with the policies set forth in the act (Sections 101[b] and 102[1]); therefore, other acts and NPS policies are referenced as applicable in the following discussion.

2.11.1 ALTERNATIVE A: NO ACTION (EXISTING MANAGEMENT CONTINUED)

Alternative A would meet the purpose of NEPA to some degree because limited protection of certain rare species and habitats would be continued, as well as the monitoring program. It would not fulfill the responsibilities of each generation as the trustee of the environment for succeeding generations and in preserving important aspects of our national heritage (purposes 1 and 4), because damage to forest vegetation and rare species would continue as a result of excessive browsing by continued high numbers of deer. Alternative A would do little to enhance the quality of renewable forest resources (purpose 6), and the expected long-term adverse impacts on vegetation, wildlife, and wildlife habitat would not ensure healthful, productive, or esthetically pleasing surroundings (purpose 2). The park would continue to attain a wide array of beneficial uses (purpose 3), although there would be continued degradation of natural and cultural resources. There would be an adverse impact on resources by allowing excessive deer browsing, which would not do anything to maintain a balance between population and resources (purpose 5). Alternative A would not enhance the quality of renewable forest resources (purpose 6).

2.11.2 ALTERNATIVE B: COMBINED NONLETHAL ACTIONS

This alternative would meet many of the purposes in NEPA to some degree, or even to a moderate degree when considering long-term results. However, it would provide only limited direct protection for forest resources (only 5 to 10 percent of woody vegetation would be protected by exclosures over the life of the plan) and it would rely heavily on an unproven technology (nonsurgical reproductive control) that might not be successfully implemented for a large, free-ranging deer population. Therefore, none of the NEPA purposes would be met to a large degree. In particular, the exclosures would detract from esthetically pleasing surroundings (purpose 2) and reproductive control methods would present an element of risk to health or safety and might have other unintended consequences (purpose 3). The lack of protection for a large percentage of the park and the time it would take for any reproductive control to be effective would mean that succeeding generations might not see desired results for some time (purpose 1). The adaptive management component of Alternative B would help achieve some balance between population and resource use (purpose 5), but the limited history of reproductive control success in free-ranging populations such as the deer herd at the park and the limits on how much forest vegetation can be

included in exclosures means that it would not be possible to completely approach the maximum attainable recycling of resources (purpose 6).

2.11.3 ALTERNATIVE C: LETHAL ACTIONS (SHARPSHOOTING AND CAPTURE/EUTHANASIA)

Alternative C would succeed to some extent in meeting all of the criteria within the life of the plan. By immediately reducing deer browsing pressure, the alternative would allow vegetation in the park to regenerate for the benefit and enjoyment of future generations (purpose 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 implementing Alternative C. By implementing proper controls, however, these concerns could be minimized. The result would be safer conditions on local roads and more aesthetically pleasing conditions throughout the park (purpose 2). Alternative C would require closures of some areas of the park during reduction activities during the life of the plan, which would limit their use by visitors. However, these closures would occur at times and places that were not high visitation periods and primarily at night when the park is closed. This alternative also would avoid undesirable consequences (e.g., potential behavioral changes from reproductive controls) and maximize forest regeneration by immediately reducing deer browsing (purpose 3). The closures within the park would limit individual choice, but only for limited periods of time. These closures would allow for the reduction of the deer population, which would protect the park's natural and cultural resources and provide greater choices in the future (purpose 4). This alternative would help to achieve a balance between population and the surrounding park resources by allowing for regeneration to occur at a higher rate than is currently occurring (purpose 5). Finally, by immediately reducing the deer browsing pressure and promoting forest regeneration, this alternative would enhance the quality of renewable resources (purpose 6).

2.11.4 ALTERNATIVE D: COMBINED LETHAL AND NONLETHAL ACTIONS

Alternative D is similar to Alternative C in the extent to which it would meet the intent of NEPA. Both would fulfill the responsibilities of each generation as a trustee of the environment for succeeding generations (purpose 1) to a large degree, because both would immediately reduce deer numbers and sustain that reduction through maintenance actions. As with Alternative C, Alternative D also would result in safer conditions on local roads and more aesthetically pleasing conditions throughout the park (purpose 2). As with Alternative B, Alternative D involves some concern about unintended consequences (purpose 3), because an acceptable reproductive control agent is not currently available and it would rely on technology that has not been proven in large, free-ranging deer populations as a long-term management tool. Although the planning team recognized the uncertainties associated with reproductive control agents, it was recognized that the science associated with this technology is developing rapidly and would provide additional information in the near future. Any safety concerns would be reduced through proper safety controls. As with Alternative C, Alternative D would also preserve important historic, cultural, and natural aspects of our national heritage in the long term (purpose 4). Alternative D would help to achieve a balance between population and the surrounding park resources by allowing for regeneration to occur at a higher rate than is currently occurring. Finally, although through a different manner than Alternative C, Alternative D would approach the maximum attainable regeneration of depletable resources (i.e., forest vegetation) by reducing and maintaining the deer population density (purpose 6).

2.12 NPS PREFERRED ALTERNATIVE

To identify the preferred alternative, the planning team evaluated each alternative based on the ability to meet the plan objectives (see Table 2-11) and the potential impacts on the environment ("Chapter 4: Environmental Consequences"). Alternative D was identified as the NPS preferred alternative.

Both Alternatives C and D would fully meet the plan objectives and are very close in their meeting of the objectives and their relative impacts. However, Alternative D would provide for the opportunity to use a wider variety of management methods, including reproductive control, which would be an option when the criteria established by the planning team are met. Alternative D would provide for an efficient initial removal of deer, and the flexibility to address future removals in different ways. If reproductive control is used, there could be reduced impacts relating to visitors, safety, and the environment, by reducing the need to close the park for extended periods of time and limiting the time that shooting would occur in the park.

Alternative B would partially meet some of the objectives, because of the lack of immediate reduction in deer numbers and the uncertainty that the deer density goal would be achieved even over an extended period of time. Alternative A (no action) would fail to meet or fully meet the objectives of the plan, since no action would be taken to reduce deer numbers or effect a change in conditions that are the basis for the purpose of and need for action.

The NPS will consider substantive comments on this plan/EIS and may modify or adjust the preferred alternative accordingly. Any modifications or adjustments will be disclosed in a final EIS. A ROD will follow the final EIS and will be made publicly available.

2.13 ENVIRONMENTALLY PREFERABLE ALTERNATIVE

The NPS is required to identify the environmentally preferable alternative in its NEPA documents for public review and comment. The NPS, in accordance with the Department of the Interior NEPA Regulations (43 CFR Part 46) and CEQ's Forty Questions, defines the environmentally preferable alternative (or alternatives) as the alternative that best promotes the national environmental policy expressed in NEPA (Section 101(b)) (516 DM 4.10). The CEQ's Forty Questions (Q6a) further clarifies the identification of the environmentally preferable alternative stating, "this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources."

Alternative D was selected 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 numbers that could be sustained with proven methods over the life of the plan. Alternative D would also best protect, preserve, and enhance the cultural and natural processes that support the park's forests and cultural landscapes by providing multiple management options to maintain low deer numbers. Although Alternatives C and D are very close in meeting the guidance for identification of the environmentally preferable alternative, Alternative D was selected primarily because it provides the park with the ability to select the least environmentally damaging option as science and technology advance. Alternatives A and B were not considered environmentally preferable because of their lack of effect on the deer population numbers, which would result in potential or continued adverse impacts on the biological and cultural resources of the park over the life of the plan.

Chapter 3

Affected Environment

CHAPTER 3: AFFECTED ENVIRONMENT

3.1 INTRODUCTION

The "Affected Environment" describes existing conditions for those elements of the natural and cultural environment that could be affected by implementation of the actions considered in this plan/EIS. The natural environment components addressed include vegetation and special-status plant species; white-tailed deer; and other wildlife, wildlife habitat, and special-status animal species. The cultural environment includes rural landscapes; socioeconomics/adjacent lands; visitor use and experience; visitor, employee, and volunteer health and safety; and park management and operations. Relevant impact topics were selected based on agency and public concerns, regulatory and planning requirements, and known or expected resource issues. The information provided in this chapter will be used as context for comparing the potential impacts of each alternative, which are presented in "Chapter 4: Environmental Consequences."

3.2 VEGETATION

3.2.1 OVERVIEW

Cuyahoga Valley National Park is located in the glaciated Allegheny Plateau of northeastern Ohio (USGS 2010), which is characterized by relatively underformed sedimentary rocks dissected by steep-sided valleys with intervening ridges and gently rolling uplands (Hacker 2004). As described in Chapter 1, the park includes a mosaic of natural vegetation types alongside various human-developed land uses (see Table 3-1 and Figure 3-1) (NPS 2011h). The park's natural vegetation is composed primarily of mixed-mesophytic forest, which is characterized by a variety of deciduous tree species growing in conditions that are neither too wet nor too dry. The oak/hickory association is the most widespread; others include maple/oak, oak/beech/maple, maple/sycamore, pine/spruce, and hemlock/beech associations (NPS 2011h). The long history of intensive land uses has left the park with forests possessing vast differences in community age and structure. Several large semi-contiguous tracts of forest remain, but most forested areas are heavily fragmented (NPS 2011h). Additionally, chestnut blight and Dutch elm disease have contributed to the complete removal of an original forest-dominant species (chestnut) and the decline of another (American elm). Figure 3-1 depicts the major land use/land cover types within the park and within 1 mile of the park boundary.

Forest vegetation

Interspersed among these forests are other natural habitats, including older field habitats in various stages of succession, wet meadows, and other wetland habitats. Agriculture activity, once widespread, continues at low levels within the park. Additionally, developed lands, including residential areas, golf courses, ski

areas, and other suburban lands exist within park boundaries (see Figure 3-1) (NPS 2011h). The park's diverse habitats support approximately 1,100 plant species, including 39 state-listed rare plant species (Plona, pers. comm., 2011), which are discussed in a separate section of this chapter.

TABLE 3-1: LAND USE / LAND COVER IN THE PARK

Land Use/Lands Cover Classification	Acreage	Percentage of Park
Mixed and deciduous forest land	23,389	71.3
Evergreen forest land	71	0.2
Forested wetlands	172	0.5
Non forested wetlands	890	2.7
Shrub and brush rangeland	1,125	3.4
Cropland and pasture	1,754	5.4
Other agricultural land	154	0.5
Orchards, groves, vineyards, nurseries	42	0.1
Transitional areas	110	0.3
Water resources	747	2.3
Other developed lands	4,353	13.3
Total	**32,807**	**100***

Source: NPS 2002j.
*Rounded to whole numbers.

3.2.2 VEGETATION COMMUNITIES

The park contains a complex set of vegetation community types. Figure 3-2 shows the typical distribution of plant communities in the Cuyahoga Valley as outlined in 1975, including forested communities, grasslands and meadows, and wetland habitats (Mosure-Fok & Syrakis Co., Ltd. et al. 1975). Although this figure was created in the mid-1970s, the distribution of plant communities in the valley is likely similar to current distribution. Therefore, this figure provides a general idea of the elevational distribution of the vegetation communities that exist within the park.

The park's vegetation community types have recently been characterized and classified as part of the NPS's ongoing inventory and monitoring efforts. Based on the park's latest plant community key (NPS 2011l), there are 44 plant communities in the park, consisting of 18 upland forests, two upland shrub communities, and five upland herbaceous communities, plus seven wetland forests, four wetland shrub communities and eight different wetland herbaceous communities. Detailed descriptions of all these communities are available through the NPS NatureServe program, currently documented in a draft entitled "Vegetation of Cuyahoga Valley National Park" (NPS 2011m). Although deer may browse on plants in all of the plant communities within the park, those communities that would be most susceptible to deer browse effects on forest regeneration are the upland forest communities (excluding conifer plantations of Norway spruce, various pines, European larch), and wetland forests. Therefore, analysis of those communities is emphasized in this plan/EIS. Table 3-2 summarizes the vegetation communities within the park, providing a brief description of dominant species by common name and other attributes noted in the database. Appendix E contains more detailed descriptions currently available from NatureServe of these upland and floodplain forest communities.

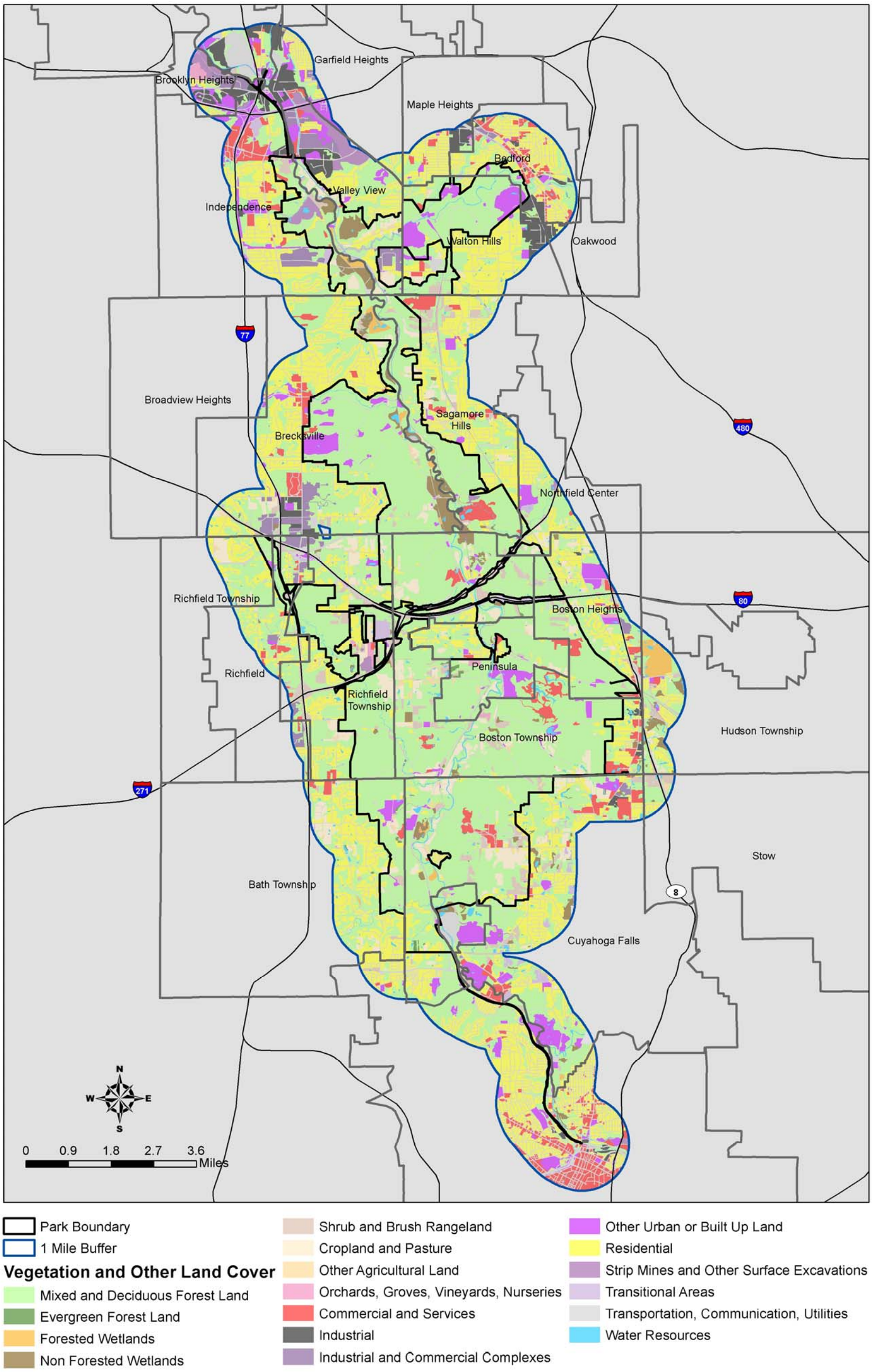


FIGURE 3-1: LAND USE / LAND COVER MAP

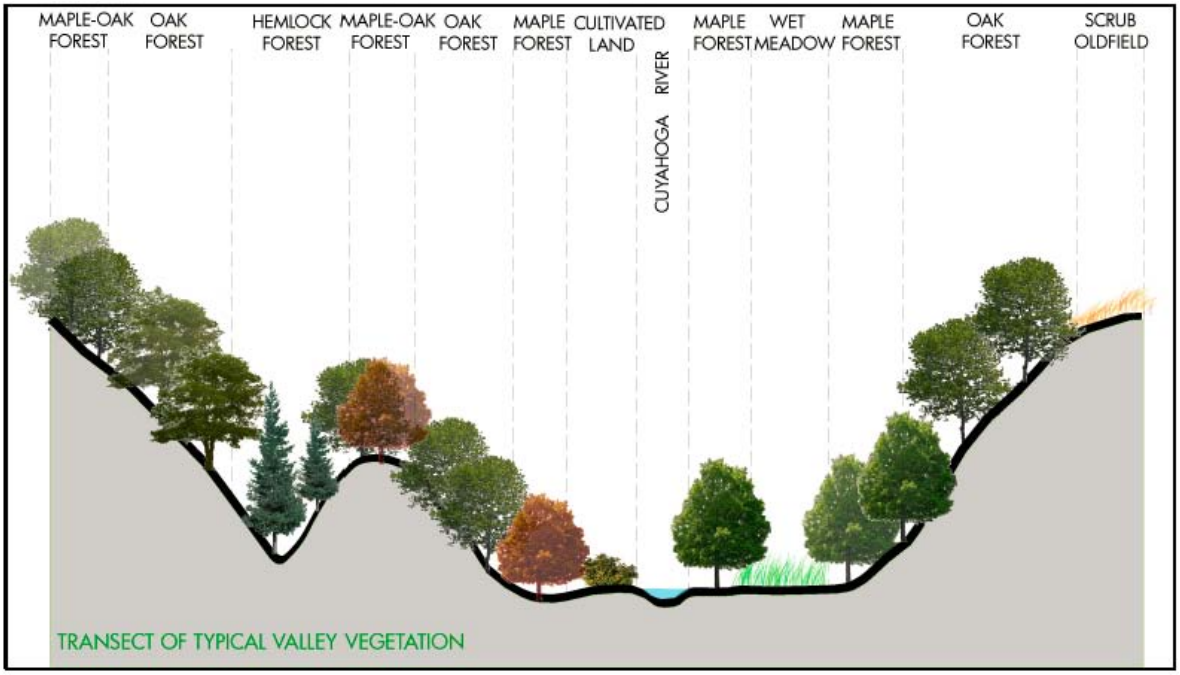


FIGURE 3-2: CROSS-SECTION OF THE CUYAHOGA VALLEY SHOWING A TYPICAL DISTRIBUTION OF PLANT COMMUNITIES

TABLE 3-2: MAJOR VEGETATION COMMUNITIES WITHIN CUYAHOGA VALLEY NATIONAL PARK

Forest Type	Community	Dominant Canopy Species/Other Dominants and Attributes
Upland Forest		
Deciduous	*Quercus velutina – Quercus alba / Vaccinium (angustifolium, pallidum) / Carex pensylvanica* Forest	*Black oak, white oak* Sites on thin soil over sandstone bedrock, eastern hemlock (*Tsuga canadensis*) is often present in the tree canopy or subcanopy, blueberries (*Vaccinium* spp.) often present in ground layer; herbaceous layer dominated by Pennsylvania sedge
	Acer saccharum – Quercus muehlenbergii Forest	*Sugar maple, chinquapin oak* Tree canopy >40% chinquapin oak (*Quercus muhlenbergii*), sites on moderate to steep slopes
	Quercus alba – Quercus rubra – Carya ovata Glaciated Forest	*White oak, Northern red oak, shagbark hickory* In the tree canopy, northern red oak (*Quercus rubra*) more abundant than black oak (*Quercus velutina*) and/or black gum (*Nyssa sylvatica*); shagbark hickory (*Carya ovata*) common. Sites typically on mid to lower slopes, shallow slopes or flats, or other dry-mesic to mesic settings
	Quercus velutina – Quercus alba – Carya (*glabra, ovata*) Forest	*Black oak, white oak, hickories* In the tree canopy, black oak (*Quercus velutina*) and black gum (*Nyssa sylvatica*) more abundant than northern red oak (*Quercus rubra*). Sites typically on upper slopes, ridges, or other dry to dry-mesic settings
	Fagus grandifolia – Acer saccharum Glaciated Midwest Forest	*American beech, sugar maple* Tree canopy >40% American beech (*Fagus grandifolia*) and/or sugar maple (*Acer saccharum*

Forest Type	Community	Dominant Canopy Species/Other Dominants and Attributes
	Robinia pseudoacacia Forest	*Black locust* Tree canopy >50% black locust (*Robinia pseudoacacia*)
	Populus deltoides Early-Successional Semi-natural Forest	*Cottonwood* Tree canopy >50% cottonwood (*Populus deltoides*), often woodland or open forest physiognomy and evidence of wet or wet-mesic conditions
	Liriodendron tulipifera – Ulmus spp. – Prunus serotina Forest	*Tuliptree, elm, black cherry* Tree canopy >30% elm (*Ulmus* spp.), tuliptree (*Liriodendron tulipifera*) often common to co-dominant in the canopy; sites near streams or wetlands
	Acer rubrum – Prunus serotina / Rosa multiflora	*Red maple, black cherry, multiflora rose in understory* Canopy dominated by red maple (*Acer rubrum*) and black cherry (*Prunus serotina*) and some sites with green ash (*Fraxinus pennsylvanica*); tuliptree (*Liriodendron tulipifera*) and aspen species (*Populus grandidentata, P. tremuloides*) <25% of canopy; understory typically contains Ohio buckeye (*Aesculus glabra*), multiflora rose (*Rosa multiflora*), wingstem (*Verbesina alterniflora*); mesic to wet-mesic sites, usually near watercourses or wet basins though rarely flooded
	Liriodendron tulipifera – Acer rubrum – Populus spp. Forest	*Tuliptree, red maple, and aspen species* Canopy dominated by tuliptree (*Liriodendron tulipifera*), red maple (*Acer rubrum*), white ash (*Fraxinus americana*), and aspen species (*Populus* spp.); associated trees in canopy or subcanopy include sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*)
Coniferous	*Tsuga canadensis – Fagus grandifolia - Acer saccharum / (Hamamelis virginiana, Kalmia latifolia)* Forest	*Hemlock, beech, sugar maple, and mountain laurel in understory* Sites not current or former tree plantations; canopy dominated by hemlock (*Tsuga canadensis*), sites with thin soil over sandstone bedrock
Mixed	*Liriodendron tulipifera – Pinus strobus - Tsuga canadensis –* Quercus (*rubra, alba*) / *Polystichum acrostichoides* Forest	*Tuliptree, Eastern white pine, hemlock; oaks* Conifer component of canopy dominated by eastern white pine (*Pinus strobus*) and/or hemlock (*Tsuga canadensis*); deciduous component dominated by oaks (*Quercus* spp.) and red maple (*Acer rubrum*)
Wetland Forest		
	Populus deltoides– Salix nigra Forest	*Cottonwood, black willow* Sites on floodplains; alluvial soils
	Populus deltoides Early-Successional Semi-natural Forest	*Cottonwood* Sites not on floodplains; evidence of extensive past disturbance
	Acer saccharinum – Ulmus americana Forest	*Silver maple, American elm* Canopy >50% silver maple (*Acer saccharinum*)
	Fraxinus pennsylvanica – Ulmus spp. *– Celtis occidentalis* Forest	*Green ash, elm, hackberry* Canopy >50% elm (*Ulmus americana, Ulmus rubra*) and/or green ash (*Fraxinus pennsylvanica*), white ash is common infrequently

Forest Type	Community	Dominant Canopy Species/Other Dominants and Attributes
	Fraxinus nigra – Acer rubrum / Rhamnus alnifolia / Carex leptalea Forest	*Black ash, red maple; alderleaf buckthorn and sedges in understory* Canopy >50% black ash (*Fraxinus nigra*), sites on muck soils
	Quercus palustris – Quercus bicolor – Acer rubrum Flatwoods Forest	*Pin oak, swamp white oak, red maple* Sites >50% swamp white oak (*Quercus bicolor*), pin oak (*Quercus palustris*), and possibly red maple (*Acer rubrum*)
	Platanus occidentalis – Acer rubrum – Fraxinus americana Forest	*Sycamore, red maple, white ash* Canopy >50% sycamore (*Platanus occidentalis*) and black walnut (*Juglans nigra*), sometimes in combination with American basswood (*Tilia americana*) and white ash (*Fraxinus americana*)

Source: NPS 2011m.

The gypsy moth has killed a large number of trees within the park. The U.S. Forest Service evaluated tree mortality in the park in 2001 and found 1,175 acres of tree mortality in 124 patches. Average tree mortality in the patches was 54 percent (Skerl, pers. comm., 2011). Although this species has primarily affected the upland ridgetops, small depressional wetlands and wetlands along drainage ways within these areas have also been affected (Davey Resource Group 2001).

Vegetation at the Park

3.2.3 INVASIVE, NONNATIVE SPECIES

Background

Invasive, nonnative plants (exotic plants) seriously threaten the integrity of native habitats, including eastern deciduous forests, by aggressively displacing and killing native plants, altering native habitats, and stifling forest regeneration (NPS 2004a). Invasive plants are those that invade a habitat, displacing native vegetation and often forming large monocultures with limited habitat value. Invasive plants have the following characteristics: they reproduce rapidly; spread over large areas of the landscape; and have few, if any, natural controls, such as herbivores and diseases, to keep them in check. Besides crowding out native plants, invasive plants may change soil and water chemistry and can influence the mix of other plants growing in their vicinity (NPS 2009g). Exotic species populations have been slowly increasing over the past century or more and seem to have exploded within the last 30 years. The exotic species problem is particularly acute in urban parklands where extensive edges and frequent human disturbances enhance opportunities for aggressive exotic plants to become established, such as at Cuyahoga Valley National Park (NPS 2004a). Deer can promote nonnative species through preferential foraging on native plants habitat alteration (disturbance to vegetation and soils from trampling) and through seed dispersal from seeds carried on their coats or found in fecal matter (Knight et al. 2009; Vellend 2002; Myers et al. 2004; Williams and Ward 2006).

Invasive, Nonnative Species in Cuyahoga Valley National Park

Currently, there are 105 nonnative plants on the park's "watch list," with 16 of these historically considered to be the most invasive within the park (Djuren and Young 2007; NPS 2010b). These plants

invade a broad range of habitats, from forests, meadows, and wetlands, to disturbed roadsides. Table 3-3 presents these species, their habitat descriptions, and parkwide coverage (NPS 2009g).

TABLE 3-3: SIXTEEN OF THE MOST INVASIVE PLANT SPECIES OCCURRING IN CUYAHOGA VALLEY NATIONAL PARK

Common Name	Scientific Name	Habitat	Parkwide Coverage (acres)
Garlic mustard	*Alliaria petiolata*	Moist ravines, dry roadsides, forest edges and interiors, floodplains	17.9–345.1
Japanese barberry	*Berberis thunbergii*	Closed-canopy forests, open woodlands, wetlands, fields, and roadsides	3.8–122.9
Autumn olive	*Elaeagnus umbellata*	Grasslands, open fields, woodlands, and disturbed areas	4.2–81.6
Common privet	*Ligustrum vulgare*	Wetlands, forests, fields, and flood plains	5.6–142.8
Japanese honeysuckle	*Lonicera japonica*	Floodplains, forest edges, and fields	2.7–69.1
Amur honeysuckle	*Lonicera maackii*	Woodlands, abandoned fields, roadsides, and marsh edges	1.2–26.9
Morrow honeysuckle	*Lonicera morrowii*	Woodlands, abandoned fields, roadsides, and marsh edges	2.8–68.9
Tartarian honeysuckle	*Lonicera tatarica*	Woodlands, abandoned fields, roadsides, and marsh edges	2.0–46.3
Purple loosestrife	*Lythrum salicaria*	Wet meadows, river and stream banks, pond edges, and ditches	1.7–32.1
Reed canary grass	*Phalaris arundinacea*	Wet meadows and swamps and along streams; may form monocultures	14.6–219.5
Common reed	*Phragmites australis*	Wetlands, often in disturbed areas	5.8–108.2
Japanese knotweed	*Polygonum cuspidatum*	Riverbanks, wetlands, waste places, and disturbed areas; mainly open areas	9.2–147.2
Glossy buckthorn	*Rhamnus frangula*	Woodlands, riparian woodlands, forest edges, old fields, and fens	—
European buckthorn	*Rhamnus cathartica*	Woodlands, riparian woodlands, forest edges, old fields, and fens	0.04–1.6
Multiflora rose	*Rosa multiflora*	Fields, forests, prairies, stream banks, and wetlands	20.4–436.5
Narrow-leaved cattail	*Typha angustifolia*	Marshes, wet meadows, ditches and along pond and lakeshores; often in disturbed areas	2.6–38.0

— = No data available.

Sources: Djuren and Young 2007; NPS 2009g.

In 2007, a survey conducted in the park found a total of 47 invasive exotic plant taxa. The survey identified 4 species as very widespread in the park, occurring in more than 40 percent of transects: multiflora rose, which is the most abundant invasive plant in the park; garlic mustard; common privet; and Japanese barberry. Common reed, Japanese knotweed, and black locust (*Robinia pseudoacacia*) were as abundant, but were localized in the park. Eight species were moderately abundant, covering between 2 and 100 acres, and the remaining 30 species covered less than 2 acres and occurred in less than 13 percent of the transects. Four species were noted as having high ecological impact: reed canary grass, autumn olive, purple loosestrife, and European alder (*Alnus glutinosa*). Eighteen species were characterized as having a high-medium or medium ecological impact, while the remaining species had medium-low ecological impacts or less (Djuren and Young 2007).

The park and all federal agencies are mandated to control invasive plants when their presence menaces natural conditions. Resources management staff uses a variety of control and management techniques, including hand pulling and spot treatments of herbicide, to try to keep nonnative invasive plant species at levels that do not threaten natural conditions. Natural areas of the park are monitored periodically to ensure the efficacy of control measures. Areas managed to date have shown a great ability to recover after removal of invasive plants. Areas that are severely infested, however, such as those with large populations of Japanese knotweed, are harder to restore by only removing problem species. As described in "Section 1.6.3, Other Vegetation Management Issues," the park has developed a volunteer-based, long-term invasive plant monitoring and control program, which features the adoption of sections of the park by volunteers who are trained to look for and control invasive plants (NPS 2009g), and a newly established exotic plant management team (EPMT) to focus on larger-scale treatment of exotic plant infestations.

Garlic mustard

3.2.4 CURRENT VEGETATION STATUS AND THE ROLE OF DEER

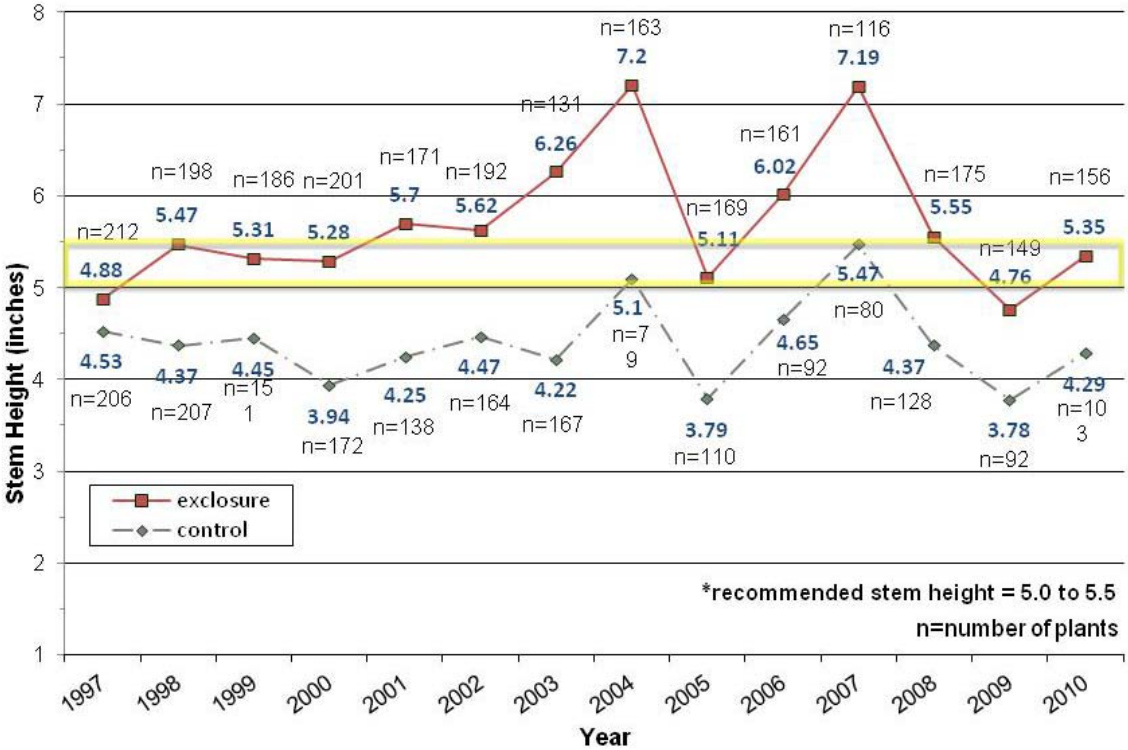
Numerous studies within eastern deciduous forests have shown that browsing by white-tailed deer at densities greater than 15 to 20 deer per square mile can influence forest regeneration success (Hough 1965; Behrend et al. 1970; Marquis 1981; Tilghman 1989; Augustine and deCalesta 2003; Bowersox et al. 2002; Horsley, Stout, and deCalesta 2003; Sage, Porter, and Underwood 2003). Deer impacts on plant communities consist of three primary effects: (1) failure to reproduce, especially in slowly maturing woody species where seedlings are killed; (2) alteration of species composition, which occurs where deer remove preferred browse species and indirectly create opportunities for less preferred or unpalatable species to proliferate; and (3) extirpation of highly palatable plants, especially those that were naturally uncommon or of local occurrence (Langdon 1985).

Vegetation monitoring results have demonstrated the role of deer in the current vegetation status of the park. As described in "Section 1.4.4, Effects of White-tailed Deer on Vegetation Structure and Species Diversity at Cuyahoga Valley National Park," the park began annual monitoring of deer-browsing impacts on the forest wildflower *Trillium grandiflorum* in 1996. Trillium stem height is a useful indicator of deer browsing intensity because it is both a preferred browse species and a sensitive species that reproduces at stem heights of 12.5 to 14 centimeters (5 to 5.5 inches) (Anderson 1994). As plants are repeatedly browsed, progressively smaller individuals are generated. Additionally, the number of plants in flower decreases (Anderson 1994) because plants must attain a minimum size to reproduce (Hanzawa and Kalisz 1993) and deer browse preferentially on larger, flowering plants (Anderson 1994).

Photo by Tom Jones

Stream showing trillium vegetation

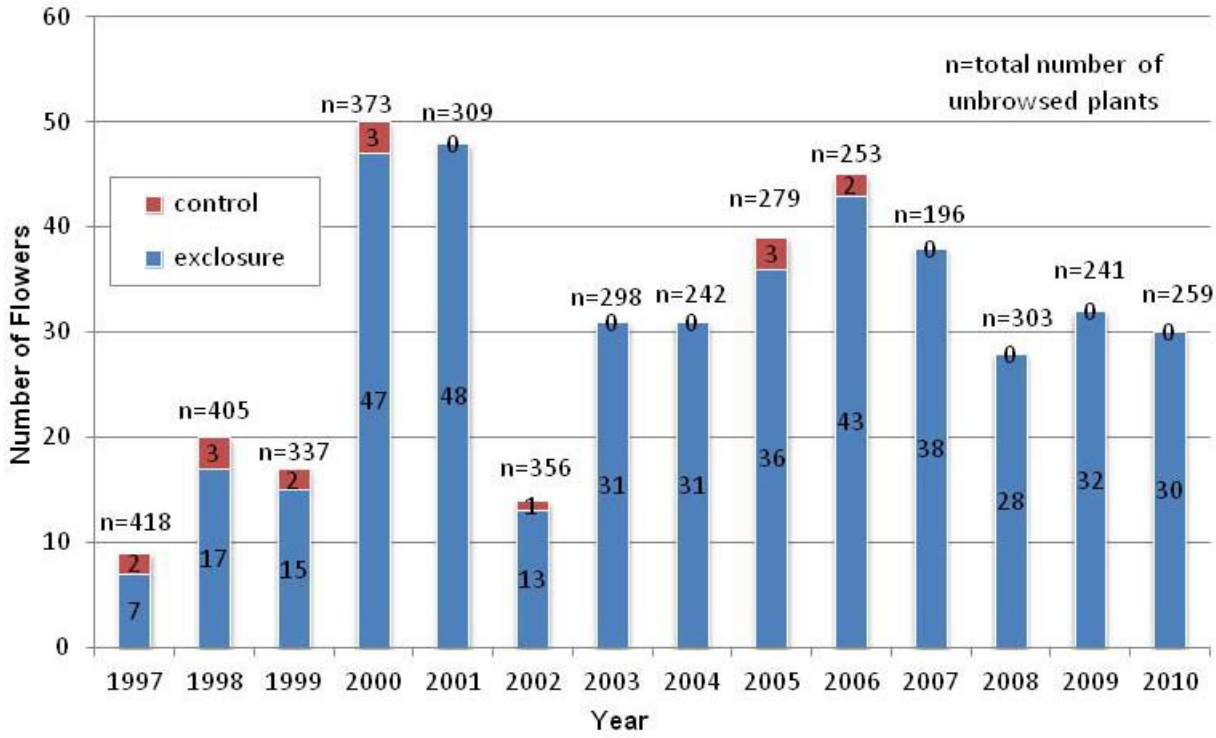
Originally, 10 monitoring sites were established to assess the effect of deer impacts on trillium populations. A total of 23 pairs of plots, each measuring 1 × 1 meter (3 × 3 feet), were established across the 10 sites. Each pair consisted of one fenced exclosure plot and one unfenced control plot open to deer browsing (NPS 2002b). Currently, 14 sites at the park are studied to assess the effect of deer impacts on trillium populations (NPS 2002a). A total of 26 pairs of plots, each measuring 1 square meter (11 square feet), are established across the 14 sites. Data collected between 1996 and 2010 demonstrate that stems were consistently taller in exclosures than controls or unfenced areas (see Figure 3-3).



Source: NPS 2009f.

FIGURE 3-3: AVERAGE STEM HEIGHT* OF UNBROWSED TRILLIUM, 1997–2010

Stems measured in control plots consistently fell below the recommended height of 12.5 to 14 centimeters (5 to 5.5 inches) required for trillium flowering (Anderson 1994). Trends in these monitoring data also show a significantly higher number of flowers in exclosures as compared to control areas; trillium inside exclosures are able to reach a stem height that allows plants to flower. These results suggest that deer browsing has a negative impact on trillium by reducing stem height and repressing flowering (NPS 2002a) (see Figure 3-4).



Source: NPS 2009f.

FIGURE 3-4: NUMBER OF TRILLIUM FLOWERS, 1997–2010

As described in Chapter 1, the park began a deer forest/field exclosure study at three sites in 1991 and expanded the study with 12 additional sites in 1999. These fenced deer exclosures, each measuring approximately 10 × 10 meters (33 × 33 feet), were paired with equal sized, unfenced plots to analyze the influence of deer on vegetation in four habitats within the park: three pairs in upland forest sites, three in bottomland forest sites, three in upland field sites, and three in bottomland field sites. Measurements of 57 parameters, including species diversity, foliage cover, and seedling regeneration, were recorded in 1999, 2001, and 2005 (forest sites only). Statistically significant differences between the fenced and unfenced plots were found in all years (NPS 2002b). Findings from the deer forest/field exclosure studies indicate that deer are impeding the growth of seedlings in bottomland forests, suppressing native groundcover diversity in upland forests, decreasing the amount of foliage in forests and fields, and enhancing the diversity and density of groundcover in upland fields. Although the impacts to upland fields could be interpreted as a positive effect, this situation could significantly slow the process of succession from open field to young forest by giving field vegetation enough of a competitive advantage that woody species are prevented from becoming established (NPS 2002b).

In addition, results from long-term ecological monitoring within the park show that areas of high deer impact experienced declining seedling abundance, seedling stocking, shrub cover, and groundcover diversity between 1998 and 2001. Deer browsing is the primary limiting factor in the height of tree seedlings—changes in the tallest seedling height were significantly different between areas with high and low deer impacts. Impacts were similar in bottomland and upland sites (NPS 2002c). Results from 2001 also show that gypsy moth defoliation could partially counteract deer impacts and may facilitate the spread of exotic plant species (NPS 2002c).

Gypsy moth caterpillar

3.2.5 VEGETATION AND THE ROLE OF CLIMATE CHANGE

Some parks are already seeing changes to vegetation and wildlife habitat and water resources as a result of climate change, and research predicts that many parks will see changes to these resources in upcoming decades (NPS 2009l). There is no documented change in vegetation as a result of climate change in the park, but funds are currently being sought to examine potential changes in vegetation community composition in response to climate change. If climate change models for the Midwest are accurate, more frequent and severe weather events, including extreme wind conditions, could increase the amount of dead woody material on the ground, increasing the risk of fire (NPS 2009m). Other potential impacts of climate change include change in plant community composition and species range, change in rare species populations, spread of invasive exotics, and change in the timing of key processes in plants, such as breaking dormancy (NPS n.d.c). The NPS climate change response program (NPS 2010f) also notes that climate change can result in a change in growing season, with the season shifting earlier in the spring in many cases. Iverson and Prasad (2002) examined environmental drivers related to current species distributions in eastern forests using regression modeling and found that suitable habitat for eastern U.S. tree species, including many of those present in the park, will likely fluctuate greatly with climate change. The current state of highly browsed ground and shrub layer vegetation in the park affects the ability of these plants to survive other stressors such as climate change.

3.3 WHITE-TAILED DEER

3.3.1 GENERAL ECOLOGY

White-tailed deer are medium-sized ungulates (hoofed animals) native to North America and are regarded as one of the most adaptable mammals in the world (Hesselton and Hesselton 1982). Among the reasons for this adaptability are the deer's hardiness and reproductive capability, the wide range of plant species they accept as food, and the tolerance they exhibit for close contact with humans.

Photo by Jerry Jelinek

Young deer

Most abundant in the eastern woodlands, white-tailed deer are typically forest edge dwellers but often frequent wetlands, meadows, or woodland openings while feeding. Deer also forage along forest margins, in orchards, and on farmlands. When deer populations become excessive,

damage to vegetation may result. Additionally, their winter food may be reduced to the point where starvation results (Martin, Zim, and Nelson 1951).

Herbaceous plants are non-woody plants, including grasses, wildflowers, and sedges and rushes (grass-like plants).

Deer are browsers during most of the year and eat warm- and cool-season herbaceous plants; soft and hard mast (e.g., acorns, hickory nuts); and buds, leaves, and twigs of woody plants. Deer preferentially use forbs in the spring and hard mast when available in the fall and winter. Native plant communities are preferred because of diversity and sustainability (Masters, Bidwell, and Elmore n.d.). Deer in Ohio eat a wide variety of items, including wild crabapple (*Malus* spp.), corn (*Zea mays*), sumac (*Rhus* spp.), Japanese honeysuckle (*Lonicera japonica*), greenbrier (*Smilax rotundifolia*), clover (*Trifolium* spp.), soybean (*Glycine max*), jewelweed (*Impatiens capensis*), dogwood (*Cornus* spp.), acorns, grasses, and miscellaneous woody plants (ODNR n.d.a). Rose and Harder (1985) conducted a study that documented the seasonal feeding habits of a white-tailed deer herd near Sandusky, Ohio, and found a heavy consumption of grass and forbs throughout the year. The herd only consumed woody browse in winter and in small amounts. The study also revealed that forage availability appeared to play the dominant role in determining the foods selected by deer (Rose and Harder 1985).

White-tailed deer are well known for their ability to rapidly increase reproductive productivity given abundant food resources, and to limit productivity in the presence of less nutritious forage (Verme 1965, 1969; Hesselton and Hesselton 1982). On good range containing abundant food, deer tend to produce more than one young, usually twins and sometimes triplets. Where food is limited, the number of births is typically restricted to a single fawn, or in some cases, no ovulation occurs (Morton and Cheatum 1946; Verme 1965; Hesselton and Hesselton 1982). Nutrition plays an important role in influencing the onset of puberty, with yearling (1.5 years) does on submarginal range possibly remaining sexually immature, whereas doe fawns on nutritious range possibly become reproductively active as early as 6 or 7 months of age (Verme and Ullrey 1984). The potential for rapid expansion of deer populations, coupled with the wide variety of plant species deer consume, can result in substantial impacts on plant communities (Marquis 1981; Shafer 1965).

3.3.2 HOME RANGE AND DEER MOVEMENT OUTSIDE THE PARK

There are currently no specific data on the home ranges of white-tailed deer within the park boundary (Petit, pers. comm., 2010d). It is generally known, however, that deer are year-round residents (i.e., they do not migrate) with home ranges between 0.5 to 2 square miles (ODNR n.d.a). Storm et al. (2007) studied space use and survival of 43 female white-tailed deer in an exurban setting near Carbondale, Illinois. Home range size averaged 0.2 square mile (53 hectares) during the fawning season and 0.35 square mile (90.6 hectares) in the winter. Deer in the exurban study area had larger home ranges than most suburban deer and generally smaller home ranges than rural deer. These findings can partially be explained by how deer habitat composition and configuration differ across the rural–urban gradient (Storm et al. 2007). Etter et al. (2002) studied survival and movements of 208 white-tailed deer in suburban Chicago, Illinois, and determined home ranges for 73 does. Mean home ranges varied by season and were larger during winter–spring (0.2 square mile [51 hectares]) than during summer (0.1 square mile [26 hectares]) and fall (0.12 square mile [32 hectares]). Mean annual home range varied from 0.04 to 0.9 square mile [10 to 234 hectares]; however, 75 percent of does had ranges less than 0.3 square mile (77 hectares) (Etter et al. 2002).

3.3.3 WHITE-TAILED DEER POPULATION SIZE AND DENSITY

As discussed in "Section 1.4, Scientific Background: Deer and Ecosystem Management," deer population numbers have been monitored at Cuyahoga Valley National Park since 1990. Spotlight counts and distance sampling, aerial surveys, fecal-pellet-group surveys, and herd health surveys have been used to monitor population density and determine trends in deer abundance over time.

Photo by Tom Jones

White-tailed deer

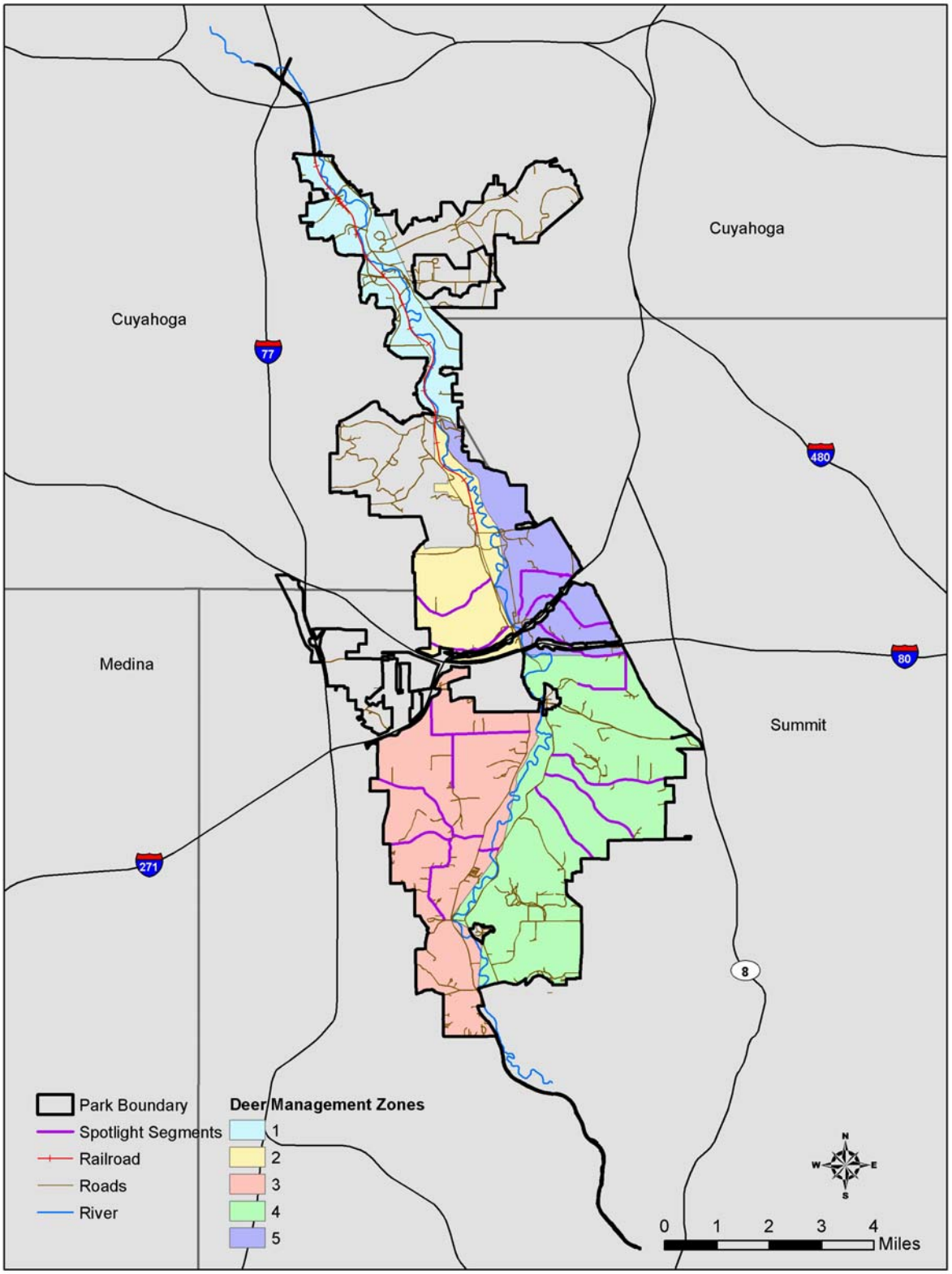
Spotlight Surveys (1990–Present)

Since 1990, annual spotlight surveys have been conducted on nearly 40 miles of roads and railroad to monitor the park's deer population (see Figure 3-5). In 1990, the average number of deer seen per night was estimated at 107 through spotlight surveys (Plona, pers. comm., 2011). Spotlight survey data suggest that the deer population increased steadily between 1990 and 1996, with the population peaking at 238 deer in 1996 (Plona 1999). Population numbers fluctuated, sometimes dramatically, between 1996 and 2004; however, estimates in 1990 (107 deer) and 2004 (281 deer) reveal an overall increase of 62 percent in the deer abundance index at the park. Although spotlight surveys are still being conducted, the park determined that reporting the average number of deer seen per night, which was done from 1990 to 2004, is not as useful as determining deer density. Therefore, the average number of deer seen per night in spotlight surveys is no longer reported (Petit, pers. comm., 2008b, 2010a), and spotlight surveys are done as part of distance sampling efforts.

Density Estimation Using Distance Sampling (1998–2010)

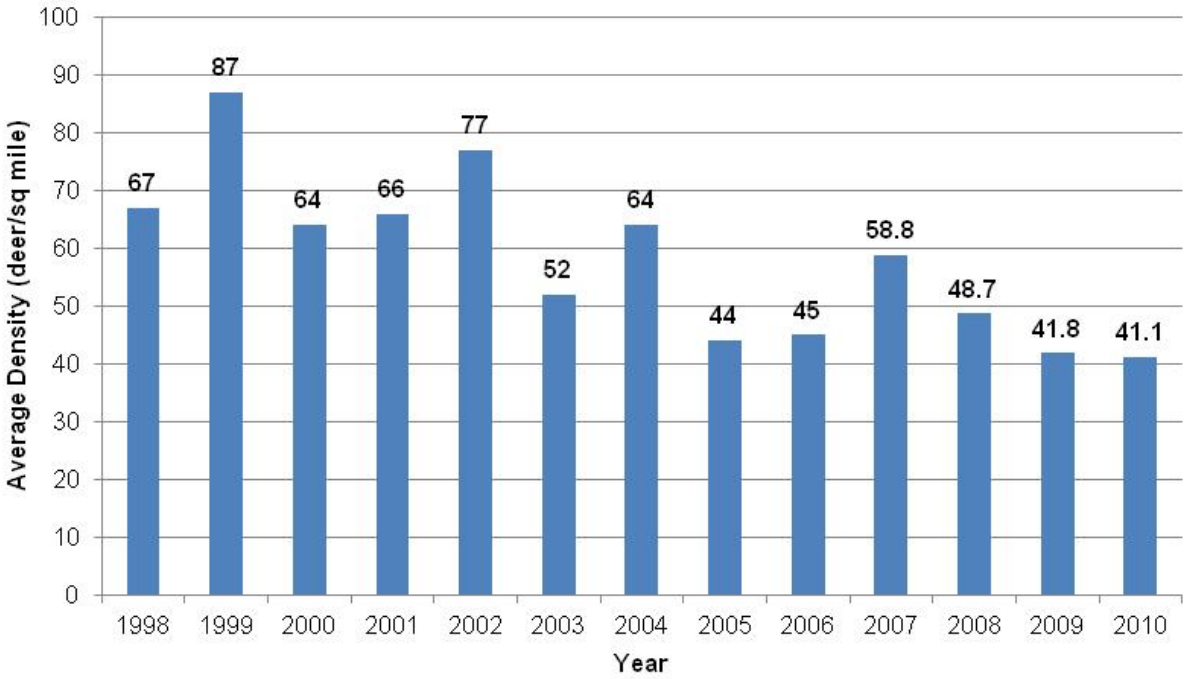
As described in Chapter 1, distance sampling methods were added to spotlight surveys in 1998 to derive better estimates of deer population density. In 1998, the population density in the park was estimated at 66.9 deer per square mile. Overall density estimates between 1998 and 2010 varied from 44 (2005) to 87 (1999) deer per square mile, with an estimated 41 deer per square mile in 2010 (see Figure 3-6).

Density estimates between 1998 and 2010 have varied from 21 to 142 deer per square mile across the five geographic zones described in Chapter 1 (see Figure 1-2). Although average park deer densities remained below 100 per square mile between 1998 and 2010, specific zones within the park, particularly zones 2 and 5, experienced deer densities above the park average and above 100 deer per square mile (Petit, pers. comm., 2011e) in several years. Deer population numbers have oscillated since the late 1990s and the average number has declined in the most recent years; however, numbers within the state and park remain at high levels.



Note: The 8-mile section of railroad is also a spotlight segment.

FIGURE 3-5: DEER SPOTLIGHT SURVEY SEGMENTS



Source: Petit, pers. comm., 2011e.

FIGURE 3-6: AVERAGE DEER DENSITY PER YEAR AT CUYAHOGA VALLEY NATIONAL PARK, 1998–2010

Deer density estimates for 2010 are shown below for five geographic zones in the park (Petit, pers. comm. 2011e)

Zone 1—Approximately 31 deer per square mile.

Zone 2—Approximately 37 deer per square mile (does not include Cleveland Metroparks land within the park).

Zone 3—Approximately 36 deer per square mile.

Zone 4—Approximately 31 deer per square mile. This is a heavily forested area relative to other areas of the park (NPS 2007a).

Zone 5—Approximately 80 deer per square mile.

Density is highest in zone 5, which has relatively little acreage owned by the local metro parks organizations, although current deer management efforts by the local metro parks occur in the middle of this zone. Table 3-4 shows the percent of each zone that is managed by metro parks organizations and has been subject to deer reductions within the park boundary in past years:

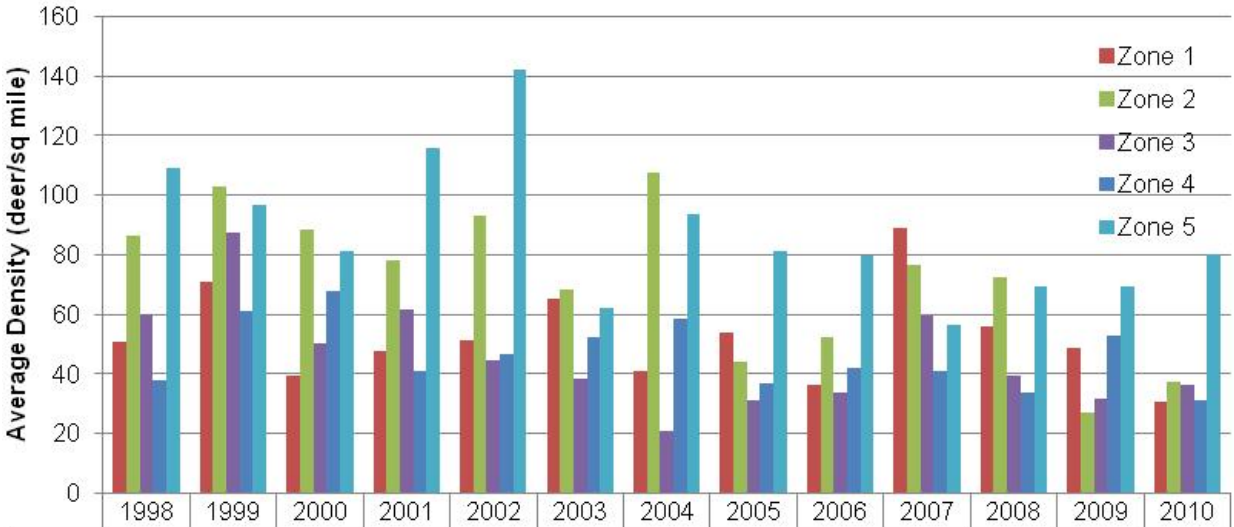
Direct Reduction — Lethal removal of deer by sharpshooting.

TABLE 3-4: PERCENT OF EACH ZONE WITHIN THE PARK MANAGED BY METROPARKS ORGANIZATIONS

Zone	Percentage
1	13.1
2	23.5
3	15.8
4	8.2
5	5.2

Source: Petit, pers. comm., 2011f.

Deer density overall has trended downward since 2002, potentially due to direct reduction actions taken on non-NPS lands within the park. In addition, there was a die-off after the harsh winter of 2005 (Petit, pers. comm., 2008c). Despite the downward trend, current deer densities remain above the desired deer density goals that support forest regeneration (see "Section 3.2.4, Current Vegetation Status and the Role of Deer"). Figure 3-7 shows the average density of deer in the park for each zone from 1998 to 2010.



	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Zone 1	50.5	71.1	39.2	47.4	51.2	65.3	41.1	54	36.4	89	55.9	48.9	30.6
Zone 2	86.5	103	88.5	78.2	93	68.5	107.5	43.9	52.1	76.5	72.6	27.1	37.4
Zone 3	59.9	87.4	50.1	61.5	44.3	38.5	20.8	31.3	33.7	59.3	39.5	31.5	36.4
Zone 4	38	61.2	67.9	40.9	46.6	52.2	58.5	36.7	41.9	40.7	33.5	53	31.1
Zone 5	109.2	96.7	81.4	115.6	142	61.9	93.7	81.3	79.4	56.5	69.5	69.4	80.1

Source: Petit, pers. comm., 2011e.

FIGURE 3-7: AVERAGE DENSITY OF DEER PER ZONE, 1998–2010

Fecal-Pellet-Group Survey (1995–Present)

As described in Chapter 1, deer fecal-pellet-group surveys have been conducted at random sites throughout the park to gain information on deer distribution and to estimate deer density. The winters of 1995–1996 and 1996–1997 indicated high concentrations of deer in several areas characterized by open shrub land habitat along the Cuyahoga River floodplain (see Figure 3-8), in what are now identified as zones 2, 3, and 5 (see Chapter 1, Figure 1-2). These particular zones provide good winter habitat for deer due to the availability of winter food supply (woody browse) and a lower amount of snow accumulation (NPS 2002g). Although the park continues to collect pellet data, the data are no longer used to derive deer density estimates. Rather than being analyzed separately, data from the fecal-pellet surveys are used as a variable in analysis of vegetation changes over time (Petit, pers. comm., 2011a).

3.3.4 WHITE-TAILED DEER BIRTH RATE

Like other prey animals, white-tailed deer reproduce at a high rate. Nixon (1971) reported a fawn to doe ratio of 1.29 fawns per doe in Ohio (statewide). The study was conducted between 1951 and 1967, at a time when deer population numbers were already rapidly increasing in Ohio. Stoll and Parker (1986) studied the reproductive performance and condition of white-tailed deer in Ohio from 1981 to 1983. They found that farmland fawn does had a higher reproductive rate (0.85 fetus/doe) than did hill country fawn does (0.62 fetus/doe). Fetus/doe ratios for yearlings (farmland = 1.89; hill country = 1.84) and adults (farmland = 1.85; hill country = 1.78) were similar and did not differ between regions (Stoll and Parker 1986).

The current birth rate for the park's deer population is unknown. However, it is known that single births, twins, and triplets occur within the herd. It is also assumed that the park's deer population maintains a birth rate similar to neighboring populations. Based on information compiled by the ODNR during the 2010–2011 deer seasons, the average fawn to adult doe ratio in the northeast region for 2010 was 1.11. The ODNR reported a 5-year average ratio of 1.07 fawns per adult doe based on data from 2006–2010 seasons (ODNR 2011). In addition, MPSSC compiled data, including estimated litter size, on harvested deer in 2008 in various areas of Summit County. Results from the data collected from the sharpshooting harvest for MPSSC areas in or adjacent to the park are detailed in Table 3-5.

No one mortality factor dominated, but some interesting patterns were observed about the timing of mortality. Fawns had high mortality during the first several weeks of life. Shortly after birth some fawns, which were too weak to nurse or were abandoned, starved. This was also a period when pneumonia or other diseases were most likely to result in sickness or death. In the summer of 2002, there were several reports of dead deer being found near ponds and streams in southeastern Ohio. It turns out that epizootic hemorrhagic disease (EHD) had infected and killed several deer in localized areas (ODNR 2005c).

Fawns in the early stages of life were also vulnerable to coyote predation; however, once the fawn reached about 1 month in age and could accompany its mother, few predator attacks were successful (ODNR 2005c). Although white-tailed deer are a dominant food item for coyotes, they are primarily scavenged as carrion (Cepek 2004); see "Section 3.4, Other Wildlife and Wildlife Habitat" for additional information.

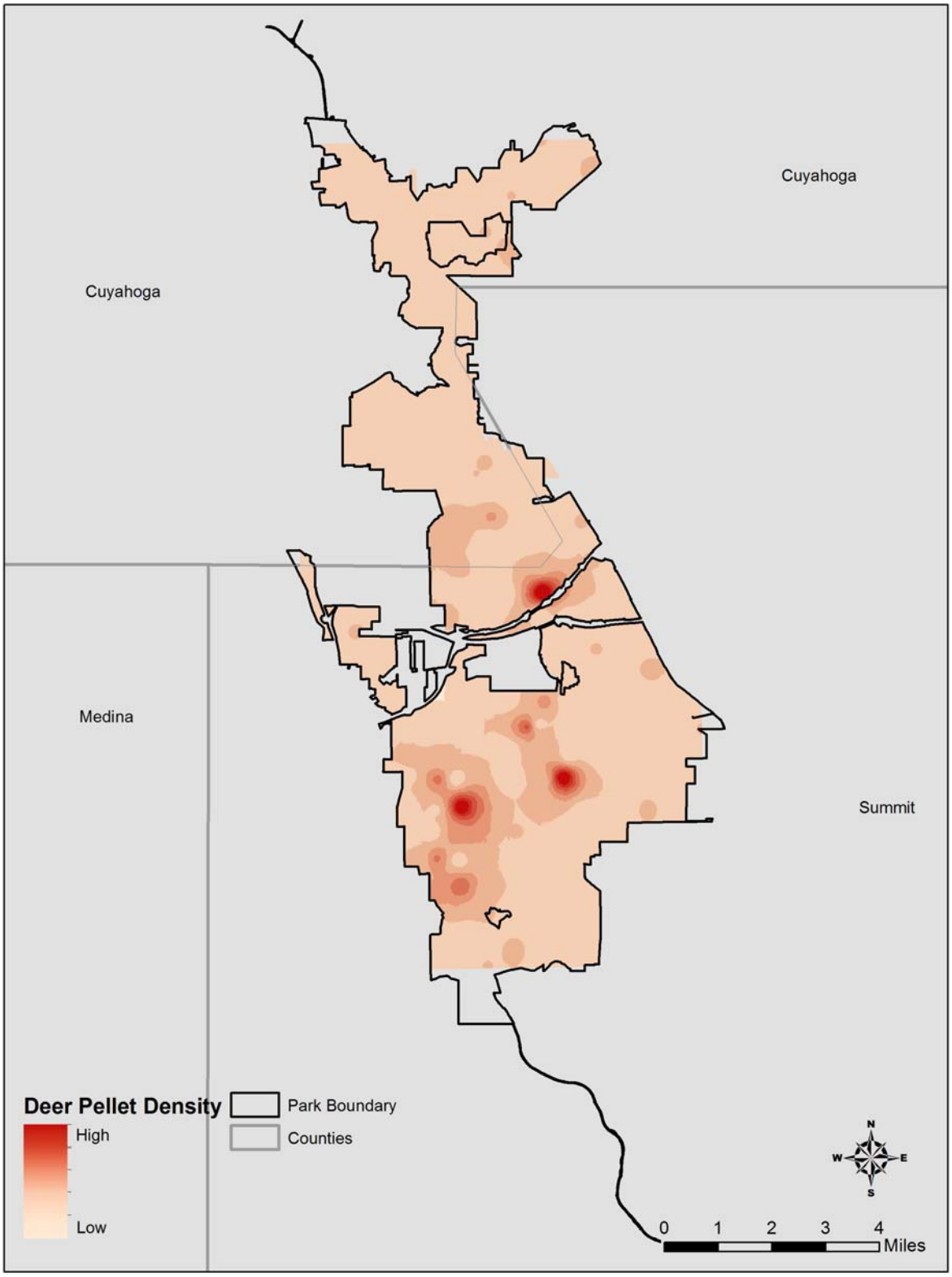


FIGURE 3-8: DEER PELLET MAP

TABLE 3-5: HARVESTED DEER DATA FOR METRO PARKS, SERVING SUMMIT COUNTY, 2007–2011

Location	Year	Total Number	Average Weight	Average Age	% Female	Average Litter
Cascade Valley	2007	23	117.73	1.8	52	1.78
	2008	41	115.85	2.2	63	1.04
	2009	—	—	—	—	—
	2010	40	112.56	1.3	50	1.11
	2011	49	116.33	2.0	61	1.33
Furnace Run	2007	11	115.45	1.7	81	1.50
	2008	—	—	—	—	—
	2009	—	—	—	—	—
	2010	—	—	—	—	—
	2011	—	—	—	—	—
Hampton Hills	2007	—	—	—	—	—
	2008	—	—	—	—	—
	2009	18	133.56	2.7	83	1.01
	2010	—	—	—	—	—
	2011	4	134.75	2.5	75	0.67
O'Neil Woods	2007	10	99.40	1.0	42	1.75
	2008	14	121.57	2.5	57	1.88
	2009	—	—	—	—	—
	2010	23	117.13	2.6	52	1.25
	2011	—	—	—	—	—
Sand Run	2007	—	—	—	—	—
	2008	47	111.04	1.8	68	0.97
	2009	26	115.31	2.0	73	1.16
	2010	—	—	—	—	—
	2011	24	127.04	2.3	83	1.6
Waldo Semon Conservation Area	2007	56	109.67	2.8	71	1.35
	2008	—	—	—	—	—
	2009	26	113.65	2.3	65	0.82
	2010	28	103.40	1.8	71	0.95
	2011	—	—	—	—	—

Source: Johnson, pers. comm., 2011.

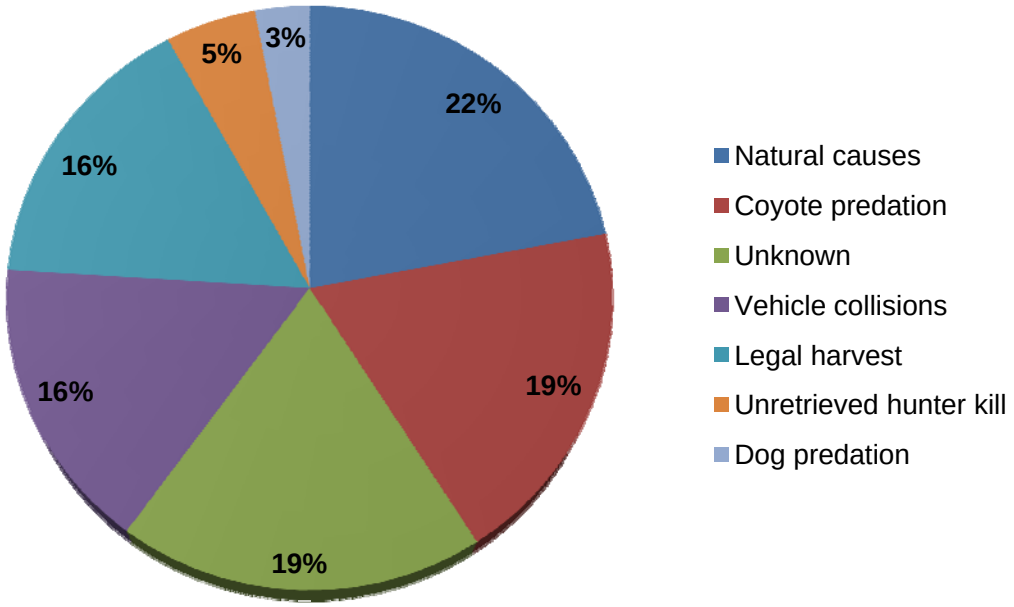
Notes: Harvesting by sharpshooting only.

Only includes MPSSC locations in or adjacent to Cuyahoga Valley National Park

— = No data available.

3.3.5 WHITE-TAILED DEER MORTALITY

The ODNR Division of Wildlife conducted a 3-year study that ended in 2004, which determined the number of white-tailed deer fawns that survived each year and what the major mortality factors were in southeastern Ohio. The results were similar to results of fawn survival studies in the Midwest and the eastern United States. The study identified the major factors contributing to deer mortality as natural causes (22 percent), coyote predation (19 percent), vehicle collisions (16 percent), legal harvest (16 percent), unretrieved hunter kill (5 percent), dog predation (3 percent), and unknown (19 percent) (ODNR 2005c). The results of this study are detailed in Figure 3-9.



Source: ODNR 2005c.

FIGURE 3-9: MAJOR MORTALITY FACTORS IN SOUTHEASTERN OHIO

The summer months were a period of relative safety for fawns as they followed their mothers around, but as fall approached and the breeding and deer hunting seasons got underway, an increase in mortality occurred. Winters in southern Ohio rarely are severe enough to cause starvation, as sometimes occurs in the snowbelt region of northeast Ohio (ODNR 2005c). The snowbelt region in northeast Ohio consists of both Summit and Cuyahoga counties (Camper 2009); therefore, it is likely that the fawns in northeast Ohio had a much lower survival rate in the winters during the study than in southern Ohio.

During the annual gun season, ODNR personnel determine the ages of approximately 5 to 7 percent of the harvest. In the 2010–2011 seasons, 5,152 deer were aged in 22 counties, which included two counties (Ashtabula and Trumbull) in the northeast region (approximately 30 to 35 miles [48 to 56 kilometers] from the park). These data are used to generate a relative composite measure of reproduction and survival, as well as population estimates for the upcoming year. According to ODNR data, the most current adult buck mortality rate for the northeast region is estimated at 0.51, which is the same as the 5-year average (ODNR 2011). Data from the 2008–2009, 2009–2010, and 2010–2011 seasons are detailed in Table 3-6.

TABLE 3-6: ANTLERED DEER MORTALITY RATE AND PRESEASON ADULT SEX RATIO IN GUN SEASON HARVEST SAMPLE FOR THE NORTHEAST REGION

Variable	2008–2009	2009–2010	2010-2011
Adult[a] buck mortality rate[b]			
5-year average	0.52[c]	0.51[d]	0.51[e]
Season estimate	0.55	0.51	0.51
Adulta sex ratio (F:M)			
5-year average	1.48[c]	1.48[d]	1.48[e]
Season estimate	1.50	1.69	1.69

Source: ODNR 2009b, 2010a, 2011.

Note: Northeast region includes Ashtabula, Trumbull, Lake, Geauga, Portage, Summit, Cuyahoga, and Medina counties.

[a] 1.5 years old and older.

[b] Estimated proportion of antlered deer that die each year from all causes.

[c] Average based on data from 2004–2008 seasons.

[d] Average based on data from 2005–2009 seasons.

[e] Average based on data from 2006–2010 seasons.

As described in "Section 1.6.1, Current Deer Management in Surrounding Jurisdictions," ODNR historically based deer management decisions on reported deer/vehicle accidents. As the buck harvest increased, so did the number of accidents reported, and vice versa. In fact, both the number of reported accidents and the total annual buck harvest increased 7 percent annually from 1977 to 2003. However, the agency has recently chosen to discontinue use of reported deer/vehicle accident data as a metric to track Ohio deer population trends because recent data suggest that the number of reported accidents may no longer track changes in the size of the deer herd. From 2003 to 2008, the number of reported accidents dropped an average of 5 percent per year. During the same period, the buck harvest had been generally trending upward. Most indices (three of four) used to track trends in deer abundance on a statewide scale suggest that the number of reported deer/vehicle crashes no longer tracks changes in the size of Ohio's deer population. This change is most likely related to changes in reporting rates over time; most insurance companies no longer require an accident report, so motorists may be less inclined to complete them except in the case of personal injury (ODNR 2009b).

3.3.6 WHITE-TAILED DEER CONDITION

As described in Chapter 1, the USGS National Wildlife Health Center surveyed the health of the park's herd between 1997 and 2001, assessing physiology, blood chemistry, and other physical health factors. Results from 2000 show decreases in fat indices, fetal rate, and twinning rate and reveal that the physical condition of the deer herd had declined from 1999 but still remained above 1997 levels (USGS 2000). The general body condition for deer examined in 2001 was considered adequate in most cases; however, twinning rate and fetal rate had decreased from values noted in 2000 (USGS 2001). The 2000 and 2001 reports concluded that if the habitat quality and deer populations remained at current levels, fawn mortality could be expected during periods of extreme winter stress (USGS 2000, 2001). Such weather-related mortality may have occurred at the park in the spring of 2005, as previously described under "Density Estimation Using Distance Sampling." Severe winter conditions and record snow levels occurred from January through March of 2005, and more than 12 inches of precipitation were recorded that winter in Ohio (National Climatic Data Center 2012). According to the park, after snowmelt in March a large number of deer carcasses were found, mostly within zones 2 and 5, where deer density estimates

were highest. The remains indicated that the deer were primarily fawns or older than 3 years. Visual observations of surviving deer in zone 5 indicated that does were emaciated and apparently not pregnant (Petit, pers. comm., 2008b, 2010c).

In addition to assessing ages, reproductive performance, and mortality, biologists from the ODNR Divisions of Wildlife conduct herd health checks in order to provide a snapshot of the relative condition of the deer herd (ODNR 2005c, 2010a). One of the best and most easily obtained measures of herd health is the size of a yearling buck's antlers; more specifically, the diameter of the main beams (or branches) just above the skull. When yearling bucks are faced with dietary deficiencies, antler development will be compromised and declines in beam diameter and number of points can be expected. Average yearling antler beam diameters for the 1977, 2008, 2009, and 2010 are presented in Table 3-7.

TABLE 3-7: AVERAGE YEARLING ANTLER BEAM DIAMETER FOR THREE REGIONS IN OHIO

Region	1977	2008	2009	2010	5-Year Mean[a]
EC-Southeast	23.3 mm	20.8 mm	20.6 mm	20.4 mm	21.0 mm
Northeast[b]	23.3 mm	20.9 mm	21.7 mm	21.7 mm	22.3 mm
Western	23.9 mm	24.4 mm	24.0 mm	24.6 mm	24.3 mm

Source: ODNR 2009b, 2010a, 2011.

[a] Average based on data from 2006–2010 seasons.

[b] Northeast region includes Summit and Cuyahoga counties.

Fluctuations in beam diameters not only signal changes in herd condition, but reproductive rates as well. It is possible, however, that short-term fluctuations simply reflect severe winter weather, drought, or a mast crop failure. Therefore, broader herd health assessments are conducted by collecting body weights, as well as estimates of births or reproductive performance, as previously described (ODNR 2005c). In 1996–1998, body weights were collected from nearly 5,500 hunter-harvested deer in 22 counties in Ohio. Results from this study suggested that both bucks and does of all ages weighed less than they did in 1981–1982. Mature bucks were the only exception. Results from the study confirmed what long-term trends in antler beam diameters of yearling bucks had suggested—a gradual but significant decline in herd condition over the previous two decades, specifically in the hill country (ODNR 2005c).

3.3.7 FACTORS THAT CAN AFFECT DEER HEALTH

Deer herds in poor physical condition have typically exceeded the nutritional carrying capacity, which is the point at which deer herd health is at equilibrium with nutritional value obtained from forage. Poor herd health indicates that the habitat has been stressed and is no longer supporting healthy deer (Eve 1981). Other primary factors affecting deer condition include disease, parasitism, and physical injury (e.g., from deer/vehicle collision).

When deer population density is high, signs of nutritional stress, such as low body and internal organ mass, low fecal nitrogen levels, and high prevalence of parasitic infections, typically occur. When deer density is reduced to the nutritional carrying capacity, all of these indicators show improved condition (Sams et al. 1998).

The park does not currently conduct any specific studies to assess the condition of deer in the park. However, visual observations are made of the herd, and deer showing visible signs of disease are noted. To date, only parasites have been noted by park staff. Although parasitism is present in the park's deer herd, prevalence is minimal. Evidence of malnutrition is periodic and associated with harsh winters with heavy, extended snow cover. There have been no known cases of deer disease in the park (Petit, pers. comm., 2011c).

3.3.8 DISEASES OF CONCERN

A number of diseases of concern exist in eastern deer populations. These include parasites, malnutrition, bluetongue virus, and EHD. CWD has recently been documented in Hampshire County, West Virginia (West Virginia Department of Natural Resources n.d.), and more recently in Gore, Virginia, and in Green Ridge State Forest, Maryland; all three areas are approximately 200 to 220 miles (322 to 354 kilometers) from the park's headquarters (Bates, pers. comm., 2011). New documented cases are being watched, as CWD is thought to spread easily in areas with high concentrations of deer. The various diseases of concern are briefly described below.

Parasitism

Parasitism occurs when an organism grows, feeds, and is sheltered on or in a different organism, resulting in a type of symbiosis in which one species benefits at the expense of the other. There are many varieties of parasites, both internal and external. Parasites can have a variety of consequences, from minimal to marked, on an individual or population.

Malnutrition

Malnutrition is the condition that develops when the body does not get adequate amounts of the vitamins, minerals, and other nutrients necessary to maintain healthy tissues and organ function. Malnutrition can be caused by exceeding the nutritional carrying capacity.

Bluetongue Virus

Bluetongue virus is an insect-transmitted viral disease of ruminant mammals and is a close relative of EHD. Bluetongue is primarily a disease of sheep, but other species such as goats, cattle, buffaloes, camels, antelopes, and deer can be infected. Humans are not infected. The disease is characterized by fever, widespread hemorrhages of the oral and nasal tissue, nasal discharge, and excessive salivation. In acute cases the tongue and nose become swollen, which may extend to the lower jaw. Additional symptoms include lameness due to swelling of the cuticle above the hoofs and emaciation due to reduced food consumption because of painful, inflamed mouths.

A ruminant animal is an even-toed, hoofed mammal (such as sheep, oxen, and deer) that chews cud and has a complex three- or four-chambered stomach.

The incidence and geographical distribution of bluetongue depends on seasonal conditions, the presence of insect vectors, and the availability of the susceptible species of animals. The insect carriers, biting midges, prefer warm, moist conditions and are most numerous and most active after it rains (USDA-APHIS 2010). Therefore, bluetongue is generally seasonal and occurs in late summer and fall (Southeastern Cooperative Wildlife Disease Study [SCWDS] 2000). The virus is present in most countries of Africa, the Middle East, India, China, the United States, and Mexico (USDA-APHIS 2010). However, bluetongue has not been detected in Ohio (Petit, pers. comm., 2011c).

Epizootic Hemorrhagic Disease

Like bluetongue virus, EHD is an insect-borne viral disease that affects ruminants. The disease causes widespread hemorrhages in mucous membranes, skin, and viscera, the result of disseminated intravascular clotting. Strains of EHD can cause widespread vascular lesions. Degenerative changes (focal hemorrhage or dry and gray-white appearance, or both) in striated musculature are prominent in the esophagus, larynx, tongue, and skeletal muscles (Stott 1998).

White-tailed deer develop signs of illness about 7 days after exposure. Deer initially lose their appetite and their fear of humans, grow weaker, often salivate excessively, develop a rapid pulse and respiration rate, and finally become unconscious (Michigan Department of Natural Resources and Environment [Michigan DNRE] n.d.). Fever is also a common characteristic of EHD, and affected animals frequent bodies of water and lie in them to reduce their body temperature (Michigan DNRE n.d.; Stott 1998). Approximately 8 to 36 hours following the onset of observable signs, deer pass into a shock-like state, become prostrate, and die (Michigan DNRE n.d.). However, not all deer infected with EHD die, because many normal deer have antibodies that indicate prior exposure to various hemorrhagic disease (HD)[1] viruses. Deer that recover develop immunity to that specific virus, which protects against re-infection by the same virus. However, it is not known how well this immunity cross-protects deer against other hemorrhagic viruses. When deer survive infection with a virus from one virus type (EHD or bluetongue virus), there is good evidence to indicate they are not protected from disease caused by subsequent infection with a different virus strain (SCWDS 2000).

EHD is responsible for significant epizootics (epidemics) in deer in the northern United States and southern Canada (Michigan DNRE n.d.). Confirmed outbreaks of EHD in Pennsylvania occurred in 2002 and 2007. The largest outbreak, in 2007, resulted in the death of over 1,000 white-tailed deer across nine counties in southwestern Pennsylvania (Pennsylvania Chronic Wasting Disease Task Force [PCWDTF] 2007). In 2002, EHD had infected and killed several deer in localized areas in southeastern Ohio. According to Mike Reynolds, Forest Wildlife Research Biologist for ODNR, EHD is the most common ailment affecting deer in the eastern United States (ODNR 2005c). However, EHD has not been detected in any counties immediately adjacent to the park (Petit, pers. comm., 2011c).

Chronic Wasting Disease

CWD belongs to a group of diseases known as TSEs, which include scrapie, BSE, and CJD. The diseases are apparently caused by infectious agents called prions, which are proteins without associated nucleic acids. Prions have high resistance both to environmental conditions and to a range of treatments that typically kill other infectious agents (Williams, Kirkwood, and Miller 2008).

Prion — Infectious particle thought to be the infectious agent for certain degenerative diseases of the nervous system such as CWD.

Deer and elk affected by CWD show loss of body condition and changes in behavior. Affected animals may demonstrate a variety of behavioral signs, including slow, repetitive behaviors (such as walking set patterns), showing periods of depression from which they are easily roused, and carrying their heads and ears lowered. Animals in the later stages of the disease become emaciated. Excessive drinking and urination are common in the terminal stages, and many animals in terminal stages exhibit excessive salivation and drooling, lack of coordination, fine head tremors, and a wide-based stance. Death is inevitable once clinical signs are visible (Williams,

[1] HD is the most important infectious disease of white-tailed deer in the United States. It is caused by either of two closely related viruses, epizootic hemorrhagic disease (EHD) virus or bluetongue virus (SCWDS 2002).

Kirkwood, and Miller 2008). The clinical course of CWD varies from a few days to approximately a year, with most animals surviving a few weeks to 3 or 4 months. While a protracted clinical course is typical, occasionally death may occur suddenly; this may be more common in free-ranging animals than in the relative security of captivity (Williams, Kirkwood, and Miller 2008).

The health risk for humans consuming elk or deer infected with CWD is unknown; however, the risk is likely extremely low and no cases of human disease have been associated with CWD. This risk is based on an analysis of existing research studies that indicate no established link between the disease and similar human transmissible encephalopathy diseases. However, in the absence of complete information and in consideration of the similarities of animal and human TSEs, caution should be taken to avoid exposure (Williams, Kirkwood, and Miller 2008). Appendix C provides additional information on CWD diagnosis and management.

After reports of CWD surfaced in Wisconsin in 2002, the ODNR Divisions of Wildlife began targeted monitoring of its deer herd. Annually, the ODA Animal Disease Diagnostics Laboratory is conducting CWD tests on more than 1,500 samples collected during the deer gun season and from usable road-killed deer (ODNR n.d.b). The park proposes to initiate its own CWD surveillance as part of each of the action alternatives described in Chapter 2. To date, CWD has not been detected in the state of Ohio (ODNR n.d.b; Petit, pers. comm., 2011c). As of January 2010, CWD has been diagnosed in wild or captive deer and/or elk in Colorado, Wyoming, Wisconsin, South Dakota, New Mexico, Utah, Nebraska, Oklahoma, Minnesota, Illinois, Kansas, Montana, New York, West Virginia, Michigan, and Virginia in the United States and in Saskatchewan and Alberta in Canada (ODNR n.d.b).

3.4 OTHER WILDLIFE AND WILDLIFE HABITAT

3.4.1 OVERVIEW

Racoon

The diversity of aquatic and terrestrial habitats at the park provides foraging opportunities, breeding habitat, and shelter for a variety of wildlife species, including endangered, threatened, and other rare animals. Surrounded by urban locales, the park's 33,000 acres contain forest, field, river, and wetland habitats. The park's fragmented configuration and land use history have a strong effect on the types of wildlife found there (NPS 2010g). Open meadows and fields offer critical habitat for birds, butterflies, and small mammals that depend on grassland habitats for survival. Forested areas in the park provide valuable habitat for larger mammals such as fox and opossum as well as for migrating songbirds and raptors. Shorebirds, waterfowl, amphibians, small reptiles, and mammals also make use of the park's wetlands and floodplains for habitat. According to the most recent park lists, animal species detected in the park include 247 species of birds, 36 mammals, 18 amphibians, and 20 reptiles. In addition, 62 butterfly species have been documented in the park (Plona, pers. comm., 2011). Many of these species are dependent on habitat that can be affected by overbrowsing, especially species that use or inhabit the herbaceous and woody vegetation in the forest understory.

3.4.2 MAMMALS

With much of the park covered with fields or forests, small mammals are abundant, making up the majority of the 36 mammal species known to occur in the park (NPS 2011d). The most common small mammals in the park include eastern cottontail rabbit (*Sylvilagus floridanus*), house mouse (*Mus musculus*), meadow vole (*Microtus pennsylvanicus*), white-footed mouse (*Peromyscus leucopus*), eastern mole (*Scalopus aquaticus*), eastern chipmunk (*Tamias striatus*), short-tailed shrew (*Blarina brevicauda*), and various species of squirrel (NPS 2009n). In addition, many of the park's wetlands are occupied by beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), and mink (*Neovison vison*) (NPS 2011d).

Photo by Bruce Winges

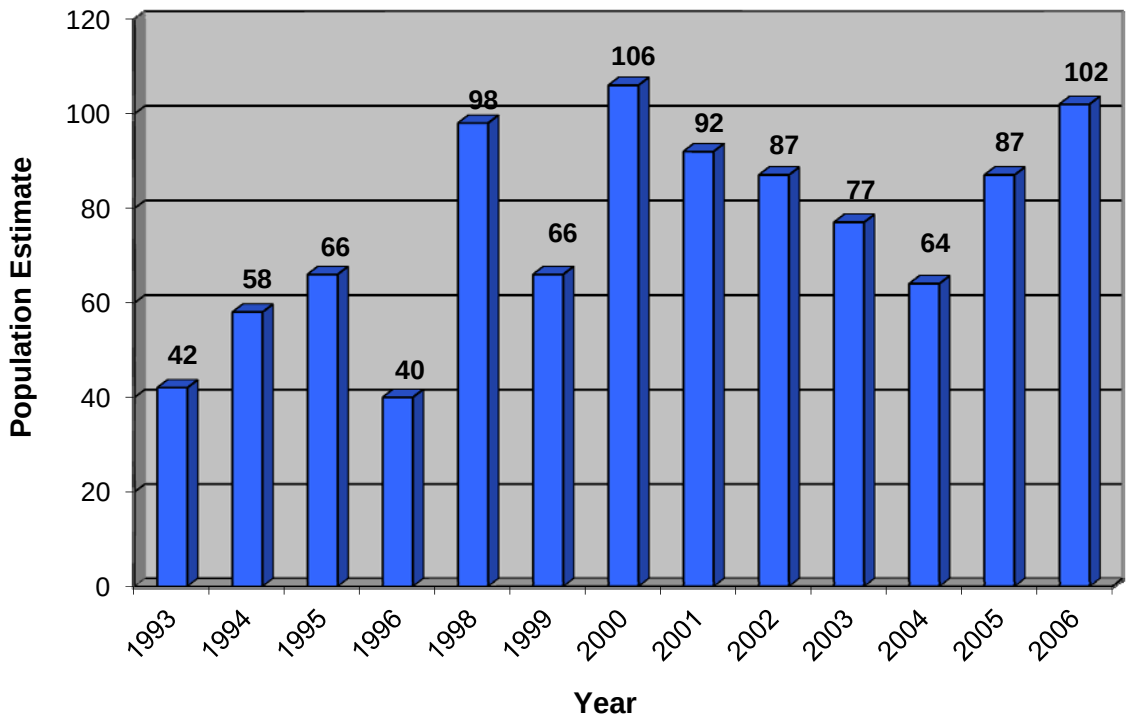
Beaver

Along roadsides, white-tailed deer and woodchucks (*Marmota monax*) graze on grasses and forbs in open fields and are among the most frequently observed mammals during the day. Raccoons (*Procyon lotor*) and opossums (*Didelphis virginiana*) are likely to be observed at night (NPS 2011d).

Coyotes (*Canis latrans*) are the dominant predator in the park ecosystem (NPS 2011d). Coyote populations in the Cuyahoga Valley region and surrounding natural areas have continued to increase over the last decade (Perdicas 2011). Although coyotes have been in Ohio for over 90 years, the first confirmed coyote in Cuyahoga County was in 1983, and population numbers have varied significantly since 1993. There are now coyotes in every county in Ohio (Cleveland Metroparks 2006b). Population estimates for the park from 1993 to 2006 ranged from 40 (1996) to 106 (2000), with an estimate of 102 coyotes for 2006 (see Figure 3-10) (NPS n.d.e). The park offers coyote edge habitat with open meadows and fields surrounded by forests, and plenty of food in the form of fruits, nuts, grains, and small mammals (NPS 2011d). Diet composition surveys conducted in the park found meadow vole, white-tailed deer, and eastern cottontail to be the predominant food items found in coyote scat. Although white-tailed deer occurred frequently in the coyote diet (occurring in 20 percent of scats), further investigation indicated that white-tailed deer are primarily scavenged as carrion (Cepek 2004). A study by MPSSC (2001b) indicates that deer remains are present in about 38 percent of the coyote scat examined. According to the Cook County Coyote Project in Illinois, coyotes cannot reduce deer populations in the Midwest because they do not often take adult deer. However, they may slow population growth in high-density areas through their predation of fawns (Gehrt 2006). Red foxes (*Vulpes vulpes*) and gray foxes (*Urocyon cinereoargenteus*) take advantage of similar food sources, but gray foxes are considered uncommon in the park (NPS 2011d).

Photo by Wilbur McQueen

Coyote



Source: NPS n.d.e.
Note: No study conducted in 1997.

FIGURE 3-10: ESTIMATED COYOTE POPULATION IN THE PARK, 1993–2006

3.4.3 BIRDS

Approximately 247 species of birds (105 of which breed in the park), including raptors (birds of prey), songbirds, and waterfowl, have been documented in the various habitats in the park (NPS 2011h, 2011c). The park also provides important habitat for several federally and state-listed bird species (NPS 2009b), which are addressed further in "Section 3.5.2, Special-status Animal Species."

Ten raptors are either summer or year-round residents of the Cuyahoga Valley (NPS 2011c). Common raptors in the park include turkey vulture (*Cathartes aura*), red-tailed hawk (*Buteo jamaicensis*), and red-shouldered hawk (*Buteo lineatus*) (NPS 2010a). A pair of peregrine falcons, which are state threatened, successfully nested in the park for the first time in 2009, producing four chicks. This same pair bred in spring 2010 (NPS 2011i), and fledged four young in 2011 as well. A second pair of peregrine falcons nested in the park in 2011, but the nest failed (Plona, pers. comm., 2011).

Photo by Sue White

Wild turkey

Many of the bird species in the park nest on or near the ground, using grasses and other low-growing vegetation for building nests and other concealment. These include killdeer (*Charadrius vociferus*), wild turkey (*Meleagris gallopavo*), field sparrow (*Spizella pusilla*), ovenbird (*Seiurus aurocapilla*), eastern meadowlark (*Sturnella magna*), and veery (*Catharus fuscescens*) (NatureServe 2009; NPS 2010a).

Other birds in the park nest in shrubs or saplings, generally within plant heights available to deer (up to approximately 6 feet [2 meters]) (Saunders 1988). These include chipping sparrow (*Spizella passerina*), yellow warbler (*Dendroica petechia*), hooded warbler (*Setophaga citrina*), indigo bunting (*Passerina cyanea*), brown thrasher (*Toxostoma rufus*), yellow-billed cuckoo (*Coccyzus americanus*), and yellow-breasted chat (*Icteria virens*) (NatureServe 2009; NPS 2010a).

Birds that nest in the upper parts of the understory or canopy of woodlands include the great horned owl (*Bubo virginianus*), Cooper's hawk (*Accipiter cooperii*), cedar waxwing (*Bombycilla cedrorum*), blue jay (*Cyanocitta cristata*), red-eyed vireo (*Vireo olivaceus*), wood thrush (*Hylocichla mustelina*), Baltimore oriole (*Icterus galbula*), eastern wood-pewee (*Contopus vierns*), and scarlet tanager (*Piranga olivacea*). The park also supports cavity-nesting birds such as the wood duck (*Aix sponsa*), pileated woodpecker (*Dryocopus pileatus*), black-capped chickadee (*Poecile atricapillus*), eastern bluebird (*Sialia sialis*), northern flicker (*Colaptes auratus*), and house wren (*Troglodytes aedon*) (NatureServe 2009; NPS 2010a).

Photo by Mac Albin

Shrubs provide nesting habitat for many birds

3.4.4 REPTILES AND AMPHIBIANS

According to current species lists, 18 species of amphibians are known to occur in the park, including 9 salamanders, 8 frogs, and 1 toad (NPS 2009c). The most common amphibians found in the park include Jefferson's salamander (*Ambystoma jeffersonianum*), gray tree frog (*Hyla versicolor*), northern chorus frog (*Pseudacris triseriata*), slimy salamander (*Plethodon glutinosus*), pickerel frog (*Rana palustris*), northern leopard frog (*Rana pipiens*), and wood frog (*Rana sylvatica*). Amphibian species considered abundant within the park include American toad (*Bufo americanus*), spring peeper (*Pseudacris crucifer crucifer*), northern dusky salamander (*Desmognathus fuscus*), two-lined salamander (*Eurycea bislineata*), red-backed salamander (*Plethodon cinereus*), bullfrog (*Rana catesbeiana*), green frog (*Rana clamitans*), and eastern newt (*Notophthalmus viridescens*) (NPS 2009d).

Most of these species can be heard or seen along remnants of the Ohio & Erie Canal, which runs the length of the park, and in many of the wetlands and ponds that dot the landscape. Salamanders are harder to find, hidden in the forest near small temporary ponds or other wet depressions in the park; however, occasionally migrations of salamanders are observed during rainy spring nights as they cross roadways to reach their breeding ponds. Amphibians are an important part of the ecological balance of many habitats, and are considered good indicators of environmental health (NPS 2009c).

Twenty species of reptiles are found in the park, including 11 snakes, 8 turtles, and 1 skink—the five-lined skink (*Eumeces fasciatus*). All species are native, with the exception of the red-eared slider (*Trachemys scripta elegans*), an exotic turtle species (NPS 2011f). The most common snakes found in the park include ring-necked snake (*Diadophis punctatus*), eastern milk snake (*Lampropeltis triangulum*), northern water snake (*Nerodia sipedon*), DeKay snake (*Storeria dekayi*), and common garter snake (*Thamnophis sirtalis*) (NPS 2009o). No poisonous snakes have been found in the park, although two species—the northern copperhead (*Agkistrodon contortrix mokasen*) and eastern Massasauga rattlesnake (*Sistrurus catenatus catenatus*)—have been identified in nearby counties (NPS 2011f). The eastern Massasauga rattlesnake is a candidate species for listing under the ESA and listed as endangered by the State of Ohio (USFWS 2011). While the type of wet habitat this snake prefers is found in the park, there is no record of this species ever occurring within the park (NPS 2011f).

The most common turtles encountered in the park include the common snapping turtle (*Chelydra serpentina*), painted turtle (*Chrysemys picta*), and nonnative red-eared slider (NPS 2009o). The spotted turtle (*Clemmys guttata*), a state-listed threatened species, was observed in the park in 2008 but is considered rare. Two other species of turtles—the eastern box turtle (*Terrapene carolina*) and Blanding's turtle (*Emydoidea blandingii*)—have been designated species of special interest in Ohio. However, none of the park's reptiles are federally threatened or endangered (NPS 2009b).

3.4.5 BUTTERFLIES

Butterflies are important pollinators and are also significant in nutrient recycling, both as consumers and as prey for other species. Many species are restricted to unique ecological conditions, making them valuable indicators of ecosystem quality and change. In 1996, the park was invited to participate in a long-term butterfly monitoring program initiated by the Cleveland Museum of Natural History. After 15 years of monitoring, a total of 62 species have been recorded along the selected transect in the park (Plona, pers. comm., 2011). The long-term project has grown to over 65 transects in 22 counties in Ohio (NPS 2011e).

The 20 most commonly seen butterflies in the park, including their preferred habitat and typical host plants, are shown in Table 3-8.

3.4.6 CURRENT STATUS OF WILDLIFE AND THE ROLE OF DEER

There is more research on the effects of deer density on vegetation than on wildlife populations. However, a number of studies have shown distinct changes in bird abundance as a result of reducing deer density by exclosures (McShea and Rappole 2000). One researcher found that songbird habitat was negatively impacted with 20 to 39 deer per square mile within a cherry/maple forest (deCalesta 1997). Similarly, a 9-year study in the mid-Atlantic region found that a reduction in deer density changed the composition of forest bird populations (McShea and Rappole 2000). Three patterns of change were observed in bird populations within exclosures (where there were no deer): (1) species that preferred open understory (e.g., wood thrush) declined; (2) species that preferred a dense herbaceous ground cover (e.g., Carolina wren) immediately increased, but then decreased as herbaceous species were replaced by woody species; and (3) species that preferred a dense, woody understory (e.g., ovenbird) gradually increased (McShea and Rappole 2000).

TABLE 3-8: TWENTY MOST COMMONLY SEEN BUTTERFLY SPECIES IN THE PARK

Scientific Name	Common Name	Habitat	Host Plant
Ancyloxypha numitor	Least skipper	Moist, open meadows	Grasses
Cercyonis pegala	Common wood nymph	Open woodlands	Grass, purpletop
Colias eurytheme	Orange sulphur	Any open area	Alfalfa
Colias philodice	Clouded sulphur	Any open area	Red clover, white clover
Danaus plexippus	Monarch	Open habitat	Milkweed
Epargyeus clarus	Silver-spotted skipper	Clover, alfalfa	Locust, hogpeanut
Erynnis baptisiae	Wild indigo duskywing	Prairie openings	Crown vetch/wild indigo
Everes comyntas comyntas	Eastern tailed blue	Open area near legumes	Legumes
Limenitis arthemis	Red-spotted purple	Deciduous woods	Wild black cherry
Limenitis archippus	Viceroy	Open area/willows	Cottonwood
Lycaena phlaeas americana	American copper	Old fields	Sheep sorrel
Megisto cymela	Little wood satyr	Shaded habitats	Virginia wildrye
Papilio glaucus	Eastern tiger swallowtail	Deciduous forest	Ash
Papilio polyxenes	Black swallowtail	Old fields	Carrot family
Phyciodes tharos	Pearl crescent	Open areas/nectar	Asters
Pieris rapae	European cabbage white	Any open area	Wild mustard, garlic mustard
Poanes zabulon	Zabulon skipper	Open forests	Purple top grass
Satyrium acadica	Acadian hairstreak	Wetlands/willows	Black willow
Speyeria cybele	Great spangled fritillary	Open woodlands	Violets
Thymelicus lineola	European skipper	Open moist areas	Timothy

As described in Chapter 1, the park conducted a forest songbird study to examine effects of deer density and browsing on the diversity and abundance of forest songbirds (Petit 1998). Sites with high and low deer density numbers (greater or less than 30 deer per square mile) supported similar total numbers of bird species, but the overall abundance of individuals was significantly lower in high deer density areas, particularly for species that typically nest and forage in forest understory. Bird abundance in sites with high deer densities was 30 percent to 65 percent lower than in sites with low deer densities. Specifically, mean abundances of wood thrushes, hooded warblers (*Setophaga citrina*), and northern cardinals (*Cardinalis cardinalis*) were 55 percent to 65 percent lower at sites with higher deer densities compared to those with lower deer densities. In addition, abundance of the subcanopy species Acadian flycatcher (*Empidonax virescens*) was 32 percent lower in high deer-density sites (Petit 1998). However, nesting success of the three most common species of forest birds tended to be greater in areas of higher deer density. This trend appears to be due to significantly higher cowbird (*Molothrus ater*) parasitism and predation frequencies in low deer-density sites where overall bird abundance was higher. Cowbirds and blue jays, which are common nest predators, tended to be more abundant in low deer-density sites, which may have contributed to higher frequencies of predation and parasitism in nests at sites with low deer density. In addition, vegetation in some areas of high deer density appeared relatively undamaged by deer, and these areas were where most birds nested. Ultimately, the number of birds actually attempting to nest at these sites was so low due to overall lower abundance that local bird diversity and productivity were significantly reduced, regardless of relatively higher nesting success (Petit 1998).

The habitat most affected by heavy deer browsing is the herbaceous and woody vegetation in the forest understory. Deer can browse vegetation from ground level to about 6 feet (2 meters) above the ground (Saunders 1988), and this is the habitat that is primarily affected. Loss of forest understory vegetation due to deer browsing may negatively impact insect populations, which are often dependent on a very narrow range of host plants (Strong, Lawton, and Southwood 1984; Stewart 2001). Loss of native nectar plants in both forests and grasslands may especially impact butterflies and other pollinators.

Other species that compete with deer for available food include squirrels and mice, which feed on acorns and other food from trees, and rabbits, which feed on young woody stems and green vegetation (McShea and Rappole 2000). This competition negatively impacts reproduction and winter survival of species such as the eastern chipmunk, gray squirrel (*Sciurus carolinensis*), and white-footed mouse (*Peromyscus leucopus*) (McShea 2000; McShea and Schwede 1993). Laux and Walton (2008) conducted research within the park and reported preliminary results suggesting that both the abundance and diversity of small mammals were reduced in areas of relatively high deer density, where understory foliage was reduced or absent. Heavy deer browsing also results in lack of cover for small mammals. Flowerdew and Ellwood (2001) suggest that if rodent densities are lowered, avian and terrestrial predators are likely to suffer reduced breeding success, and tawny owls (*Strix aluco*) may prey more heavily on bank voles (*Myodes glareolus*) if their favored groundcover is reduced.

Species that primarily depend on other habitats would be less affected by high deer numbers. Some frogs, snakes, salamanders, and turtles (e.g., wood frog, spotted salamander) live close to water during much of their lives and are therefore less affected by deer. In fact, in a comparison of deer exclosures and unfenced control plots, Greenwald, Petit, and Waite (2008) found that the abundance of garter snakes and red-backed salamanders was much higher in areas open to deer browsing, possibly due to higher abundances of some invertebrate species in the unfenced areas. However, other species (e.g., box turtle) are dependent on vegetation, fruits, and insects that are found within the understory of the forest, and their habitat is adversely affected by high deer numbers.

Species that could benefit from high deer numbers and resulting habitat changes are those that prey on deer (e.g., coyotes) or that feed on carrion (e.g., coyotes, vultures and crows). Predators would also benefit from hunting other prey, such as mice and squirrels, in areas with less dense cover at ground level, thus allowing better views through the forest and less cover for prey to hide. However, as prey declines due to reduced cover, predators also decline.

The upper canopy of the forest has not changed noticeably to date as a result of high deer numbers. Therefore, those species that depend on the upper canopy of the forest, such as woodpeckers and other birds that nest high in the trees, have not experienced any noticeable change in their habitat. As the forest ages, improved habitat may become available for cavity-nesting birds and birds that feed on insects as older trees die or become stressed from disease or infestations. However, in the long term with little to no regeneration, the dead trees will not be replaced by new trees, resulting in fewer trees that upper canopy species can use as habitat.

3.5 SPECIAL-STATUS SPECIES

Special-status species include federally and state-listed species. Federally listed species are those that are afforded special protection by the ESA due to their rare or threatened existence. State-listed species are considered rare or threatened within a specific state and are protected by state legislation. The diversity of aquatic and terrestrial habitats at the park provides foraging opportunities, breeding habitat, and shelter for a variety of species, including endangered, threatened, and other rare plants and animals (NPS 2010g). The NPS is required under the ESA to ensure that federally listed species and any designated critical habitats are protected on lands within the agency’s jurisdiction. In addition, the NPS considers state-listed

or other rare species similarly in taking actions that may affect these species. An overabundance of deer and deer management actions have the potential to affect listed species as well as other wildlife.

3.5.1 SPECIAL-STATUS PLANT SPECIES

No federally listed plant species are known to occur in the park (NPS 2009b). The U.S. Fish and Wildlife Service (USFWS) indicates that Summit County is one of the Ohio counties in which the federally threatened northern monkshood (*Aconitum noveboracense*) occurs (USFWS 2011); however, this species is not known to occur in the park. More information regarding the northern monkshood can be found in "Section 1.8.2, Issues and Impact Topics Considered but Dismissed from Further Analysis." Thirty-nine state-listed rare plant species are known to occur within the legislative boundary of the park (Plona, pers. comm., 2011). These plants occur in various habitats in the park, including forests, fields, wetlands, and developed and residential areas (NPS 2009a). Table 3-9 presents a simplified list of the state-listed plant species known to occur within the park. Appendix A includes a complete listing of these plants and provides information on preferred habitat and palatability to deer (if documented).

3.5.2 SPECIAL-STATUS ANIMAL SPECIES

The Indiana bat (*Myotis sodalis*) is the only federally listed animal species known to occur in the park. This bat is both a federally and state-listed endangered species and was recorded for the first time in the park in 2002 (NPS 2010g). As mentioned in "Section 1.8.2, Issues and Impact Topics Considered but Dismissed from Further Analysis," the Indiana bat is only active at night and hibernates during winter months, when most of the management activities proposed in this plan/EIS would occur. Because possible adverse impacts from implementation of this plan/EIS would be negligible to minor, this federally listed species was dismissed from further analysis (see Chapter 1).

Photo by Lisa Romaniuk

Herons

There are numerous state-listed animal species identified by the ODNR that inhabit the park. The first list of Ohio's endangered wildlife was adopted in 1974 and an extensive examination of the list is conducted every 5 years. In 2001, as part of ODNR's comprehensive management plan, a reevaluation of the endangered species list was initiated resulting in the need for an additional state-list category: "special interest" (ODNR 2010b). Table 3-10 presents a simplified list of the state-listed animal species known to occur within the park. Appendix A includes a detailed list of those animal species within the park identified by the ODNR as needing protection, with information on habitat preferences and migratory status (where applicable).

TABLE 3-9: STATE-LISTED PLANT SPECIES KNOWN TO OCCUR WITHIN THE PARK

Scientific Name	Common Name	State Status[a]
Aralia hispida	Bristly sarsaparilla	E
Carex arctata	Drooping wood sedge	E
Desmodium glabellum	Hairy tick-trefoil	E
Eleocharis ovata	Ovate spikerush	E
Equisetum variegatum	Variegated scouring-rush	E
Juniperus communis	Ground juniper	E
Panicum philadelphicum	Philadelphia panic grass	E
Poa saltuensis	Pasture blue grass	E
Scirpus americanus	Olney's three-square	E
Silphium laciniatum	Compass-plant	E
Carex cephaloidea	Thin-leaved sedge	T
Chimaphila umbellata	Pipsissewa	T
Chrysogonum virginianum	Golden-knees	T
Elymus trachycaulus	Bearded wheat grass	T
Juncus greenei	Greene's rush	T
Oryzopsis asperifolia	Large-leaved mountain-rice	T
Penstemon canescens	Gray beard-tongue	T
Rhododendron maximum	Great laurel	T
Solidago squarrosa	Leafy goldenrod	T
Triglochin maritimum	Common arrow-grass	T
Acorus americanus	American sweet-flag	P
Carex alata	Broad-winged sedge	P
Carex argyrantha	Silvery sedge	P
Carex aurea	Golden-fruited sedge	P
Carex bebbii	Bebb's sedge	P
Castanea dentata	American chestnut (fruiting)	P
Corallorhiza maculata	Spotted coral-root	P
Cornus rugosa	Round-leaved dogwood	P
Corydalis sempervirens	Rock harlequin	P
Gentianopsis crinita	Fringed gentian	P
Lechea intermedia	Round-fruited pinweed	P
Poa languida	Weak spear grass	P
Potamogeton natans	Floating pondweed	P
Sagittaria rigida	Deer's-tongue arrowhead	P
Shepherdia canadensis	Canadian buffalo-berry	P
Sphenopholis pensylvanica	Swamp oats	P
Spiranthes lucida	Shining ladies'-tresses	P
Spiranthes magnicamporum	Great Plains ladies'- tresses	P
Thuja occidentalis	Arbor vitae	P

Sources: NPS 2009b, 2011g.

[a]State status: E = state endangered, T = state threatened, P = state potentially threatened

TABLE 3-10: STATE-LISTED ANIMAL SPECIES KNOWN TO OCCUR WITHIN THE PARK

Scientific Name	Common Name	State Status
Mammals		
Myotis sodalis	Indiana bat	Endangered
Condylura cristata	Star-nosed mole	Species of Concern
Birds		
Botaurus lentiginosus	American bittern	Endangered
Bublucus ibis	Cattle egret	Endangered
Chlidonias niger	Black tern	Endangered
Circus cyaneus	Northern harrier	Endangered
Sphyrapicus varius	Yellow-bellied sapsucker	Endangered
Vermivora chrysoptera	Golden-winged warbler	Endangered
Bartramia longicauda	Upland sandpiper	Threatened
Catharus guttatus	Hermit thrush	Threatened
Empidonax minimus	Least flycatcher	Threatened
Falco peregrinus	Peregrine falcon	Threatened
Haliaeetus leucocephalus	Bald eagle	Threatened
Ixobrychus exilis	Least bittern	Threatened
Junco hyemalis	Dark-eyed junco	Threatened
Nycticorax nycticorax	Black-crowned night heron	Threatened
Pandion haliaetus	Osprey	Threatened
Accipter striatus	Sharp-shined hawk	Species of Concern
Ammodramus henslowii	Henslow's sparrow	Species of Concern
Ardea alba	Great egret	Species of Concern
Cistothorus palustris	Marsh wren	Species of Concern
Cistothorus platensis	Sedge wren	Species of Concern
Colinus virginianus	Northern bobwhite	Species of Concern
Coragyps atratus	Black vulture	Species of Concern
Dendroica cerulean	Cerulean warbler	Species of Concern
Dolichonyx oryzivorus	Bobolink	Species of Concern
Gallinula chloropus	Common moorhen	Species of Concern
Porzana carolina	Sora rail	Species of Concern
Protonotaria citrea	Prothonotary warbler	Species of Concern
Rallus limicola	Virginia rail	Species of Concern
Aegolius acadicus	Northern saw-whet owl	Species of Interest
Anas acuta	Northern pintail	Species of Interest
Anas americana	American wigeon	Species of Interest
Anas clypeata	Northern shoveler	Species of Interest
Anas crecca	Green-winged teal	Species of Interest
Anas strepera	Gadwall	Species of Interest
Asio flammeus	Short-eared owl	Species of Interest
Asio otus	Long-eared owl	Species of Interest
Aythya americana	Redhead duck	Species of Interest

Scientific Name	Common Name	State Status
Carpodacus purpureus	Purple finch	Species of Interest
Certhia americana	Brown creeper	Species of Interest
Dendroica caerulescens	Black-throated blue warbler	Species of Interest
Dendroica fusca	Blackburnian warbler	Species of Interest
Dendroica magnolia	Magnolia warbler	Species of Interest
Egretta caerulea	Little blue heron	Species of Interest
Gallinago delicata	Wilson's snipe	Species of Interest
Oporonis philadelphia	Mourning warbler	Species of Interest
Oxyura jamaicensis	Ruddy duck	Species of Interest
Regulus satrapa	Golden-crowned kinglet	Species of Interest
Seiurus noveboracensis	Northern waterthrush	Species of Interest
Sitta canadensis	Red-breasted nuthatch	Species of Interest
Spinus pinus	Pine siskin	Species of Interest
Troglodytes hiemalis	Winter wren	Species of Interest
Wilsonia canadensis	Canada warbler	Species of Interest
Xanthocephalus xanthocephalus	Yellow-headed blackbird	Species of Interest
Reptiles		
Clemmys guttata	Spotted turtle	Threatened
Emydoidea blandingii	Blanding's turtle	Species of Concern
Regina septemvittata	Queensnake	Species of Concern
Terrapene carolina	Eastern box turtle	Species of Concern

Source: NPS 2009b, 2011g; Petit, pers. comm., 2011h.
Note: State status terms are defined in Appendix A.

3.6 RURAL LANDSCAPES

As noted in Chapter 1, the park's rural landscape is a type of cultural landscape, which is a type of cultural resource. A cultural landscape is defined by the Secretary of the Interior's standards as a geographic area (including both cultural and natural resources and the wildlife or domestic animals therein) associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values (NPS 1996). Rural landscape is the term given to the agricultural cultural landscape resources at the park. According to the Rural Landscape Management Program / EIS, the rural landscape is a landscape that exhibits the historic activity as well as the cultural and aesthetic values associated with agriculture (NPS 2003). The park manages a number of rural landscapes within its boundaries.

Cultural Landscape — A geographic area associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values.

Rural Landscape — A type of cultural landscape that exhibits the historic activity as well as the cultural and aesthetic values associated with agriculture.

Distinct from designed landscapes, a rural landscape is characterized by large acreage and a proportionally small number of buildings and commonly reflects the day-to-day occupational activities of people engaged in traditional work, such as mining, fishing, and various types of agriculture (NPS 1999a). During the Euro-American settlement of the Cuyahoga Valley in the 19th century, 60 to 90 percent of the landscape in most townships was converted to agriculture, particularly because of efficient transportation of goods via the Ohio & Erie Canal and the railroad system (Kelsey 2002).

Photo by Ted Toth, NPS

Sheep herding

At a parkwide scale, the rural landscape is physically characterized by the spatial organization and land use patterns created by contrasting patterns of farmsteads, hardwood forests, open meadows, row crops, and pastures. At a smaller scale, farms are independent rural landscapes that also serve as component landscapes to the larger parkwide landscape. Farms are typically composed of the farmstead (house, barns, and outbuildings) and associated lands. Farmhouses are usually closest to the road and close to farm outbuildings and fields (NPS 2003).

Approximately 1,984 acres of land account for the rural landscape located throughout the park, consisting of cropland, pasture, orchards, groves, vineyards, and nurseries (NPS 2003). About 85 properties with about 1,345 acres of federal land contribute to the contemporary rural landscape of the park (NPS 2003). This represents about 7 percent of the park's federally owned land, or about 4 percent of the land within the park's legislative boundary. Thirty-four of the rural landscape properties with structural components (primarily farm structures) are listed in the NRHP. Other components vary in size and use, and many are covered by various permits, agreements, and easements to retain their agricultural use or vistas. Rural landscape components are found throughout the park; detailed maps are available in the *Rural Landscape Management Program EIS* (NPS 2003).

As of 2003, approximately 1,180 acres of land within the park are actively farmed (NPS 2003). In addition, 11 Countryside Initiative Program farmsteads within the park are currently active, as well as 14 short-term Agricultural Special Use Permits. The Countryside Initiative farms account for approximately 234 acres of farmed land while the Agricultural SUPs account for approximately 187 acres (Kelbach, pers. comm., 2011). The Countryside Initiative Program is an effort to rehabilitate and revitalize 19th- and 20th-century farms across the Cuyahoga Valley to preserve the park's rural landscape. The rehabilitation of these farms would help preserve public use and enjoyment of the historic, scenic, natural, and recreational values associated with the park, particularly the park's rural landscape. The program is a partnership between the park, the nonprofit Countryside Conservancy, and the lessee farmers. Through this program, the park intends to preserve and protect agricultural resources in the park more effectively. The program has a goal of more than 1,300 acres of agricultural production over a period of 10 to 15 years. Currently, there are 53 active fields in the Countryside Initiative Program within the park. Pasture occupies the greatest acreage, totaling 62.5 acres, followed by row crops and mowed areas. Total acreage by all field uses in the program is shown in Table 3-11.

Photo by Sara Guren

Farm building

TABLE 3-11: COUNTRYSIDE INITIATIVE PROGRAM ACREAGE BY FIELD USE, 2009

Field Use	Acreage
Pasture	62.5
Crops	39.6
Mow	39.6
Crops/orchard	29.7
Chickens	16.8
Vineyard/winery	13.6
Orchard/mow	10.9
Berries	7.6
Vineyard	6.3
Flowers/hoop houses	2.8
Herbs/hops	1.9
Orchard	1.3
Garden	0.45
Barnyard	0.3
Lawn	0.3
Crop	0.2
Total	**233.85**

Source: NPS 2009p.

Note: Figures change over time as farm use is dynamic. In particular, rotation methods are implemented as a sustainable farming practice.

Fences are traditional character-defining elements of the rural landscape. Fencing serves to organize and regulate the landscape, from boundary and field delineations to farmyard spaces. For farmers, fencing also serves to provide protection from wildlife predation, as well as keep livestock in. All 11 farms in the Initiative Program use fences, at least in part to protect fields from deer browsing and resultant crop damage. Currently, 67 of the 234 acres of fields (27 percent) are fenced (both permanent and temporary fencing) (Kelbach, pers. comm., 2011; NPS 2009p). Temporary fences are used to help with rotations within permanently fenced fields (Kelbach, pers. comm., 2011).

The park contains the Virginia Kendall State Park Historic district, which is “the premier historic designed landscape” of the park (NPS 2000c). This district is a significant cultural landscape contributing to the cultural resource theme of recreation and has been included under the rural landscape topic for analysis in this EIS. Deer can negatively impact vegetation in designed wooded areas such as this historic district and consequently affect its recreation purpose and cultural value.

3.7 SOCIOECONOMICS/ADJACENT LANDS

The primary socioeconomic issue addressed by this plan is the potential for an overabundance of deer to browse landscape vegetation or crops on neighboring properties, which could result in economic loss to property owners in the form of landscape or crop damage or a decrease in property values related to loss of landscaping. Losses would vary by the extent of damage and type of land use.

Land uses and socioeconomic information, such as property values, are described in this section. Socioeconomic information was obtained from the U.S. Census for the state, counties, and census block groups located in the park and within 1 mile of the park's boundary.

3.7.1 LAND USE PATTERNS WITHIN AND AROUND THE PARK

Existing land uses in the park are organized into 17 categories presented in Table 3-12. Land uses bordering the park (within a 1-mile radius) are presented in Table 3-13. Figure 3-1 depicts land use both within the park and outside the park but within 1 mile of the park's boundary.

Since the park's creation, commercial and residential development has increased along I-77—the main north–south artery just west of the park. Land uses in and around the park are a mosaic of residential, commercial, urban, agricultural, and forested areas, with more forest and agricultural uses within the park boundaries and a range of residential and commercial land uses outside the park but within a mile of the park boundaries. There are numerous residential neighborhoods adjacent to the park.

TABLE 3-12: LAND USE IN THE PARK

Land Use	Acreage	Percent
Commercial and services	690	2.1
Cropland and pasture	1,754	5.3
Evergreen forest land	71	0.2
Forested wetlands	172	0.5
Industrial	22	0.1
Industrial and commercial complexes	6	0.0
Mixed and deciduous forest land	23,389	71.3
Non forested wetlands	890	2.7
Orchards, groves, vineyards, nurseries	42	0.1
Other agricultural land	154	0.5
Other urban or built up land	1,280	3.9
Residential	1,042	3.2
Shrub and brush rangeland	1,125	3.4
Strip mines and other surface excavations	131	0.4
Transitional areas	110	0.3
Transportation, communication, utilities	1,182	3.6
Water resources	747	2.3
Total	**32,807**	**100***

Source: NPS 2002j.
*Rounded to whole numbers.

TABLE 3-13: LAND USE FOR LANDS WITHIN 1 MILE OF THE PARK BOUNDARY

Land Use	Acreage	Percent
Commercial and services	2,691	5.1
Cropland and pasture	1,545	3.0
Evergreen forest land	19	0.0
Forested wetlands	243	0.5
Industrial	1,577	3.0
Industrial and commercial complexes	1,188	2.3
Mixed and deciduous forest land	15,532	29.7
Non forested wetlands	368	0.7
Orchards, groves, vineyards, nurseries	125	0.2
Other agricultural land	99	0.2
Other urban or built up land	2,538	4.9
Residential	16,954	32.4
Shrub and brush rangeland	1,271	2.4
Strip mines and other surface excavations	506	1.0
Transitional areas	343	0.7
Transportation, communication, utilities	6,677	12.8
Water resources	636	1.2
Total	**52,312**	**100***

Source: NPS 2002j.
*Rounded to whole numbers.

Within the park boundary, more than 71 percent of land use in the park is classified as “mixed and deciduous forest land.” There is a small amount of “residential” (approximately 3.2 percent) and an additional 3.9 percent classified as “other urban or built up land.” Less than 1 percent of park land is classified as “orchards, groves, vineyards, nurseries” or “other agricultural land.”

Areas serving residential and commercial purposes are generally concentrated in Peninsula, Boston, and residences along Tinker’s Creek Road. Business types such as golf courses and ski areas are established inside the park’s legislative boundary. Farms within the park’s boundary provide a variety of vegetables, herbs, poultry, Christmas trees, and pumpkins to the public. Additional farms recently established under the CI Program provide row crops, vegetables, berries, grapes and wine, and livestock, such as poultry, goats, and sheep.

Land use surrounding the park consists primarily of developed land (including residential uses as well as industrial and commercial complexes) in the various municipalities adjacent to the park (see Figure 3-1). Land classified as “other urban or built up land” is primarily concentrated north and south of the park, representing development associated with the nearby cities of Cleveland and Akron.

As shown in Table 3-13 and on Figure 3-1, there is a large amount of residential use surrounding the park; approximately 32.4 percent, or 16,954 acres of land, located within 1 mile of the park’s boundaries is classified as residential. Approximately 29.7 percent, or 15,532 acres, is classified as “mixed and

deciduous forest land" and approximately 12.8 percent is classified as "transportation, communication, and utilities."

3.7.2 LANDSCAPING/CROP DAMAGE AND PROPERTY VALUES

Economic impacts from the current deer population can result in the form of damage to residential landscaping and agricultural crops. The following provides an overview of residential property values in the region and the types of damages that nearby property owners may incur from the existing and future deer populations.

Property Values

In 2000, the median residential property value of owner-occupied units in Cuyahoga and Summit counties was $164,972 and $158,159, respectively, while the median value in the state overall was considerably lower, $103,700 (U.S. Census Bureau 2011). Most of the census block groups in Cuyahoga and Summit counties whose boundaries intersect with the park report a notably higher median value for owner-occupied units than those located within a mile of the park and in the respective county overall. Nine of these 13 block groups that intersect the park in Cuyahoga County had a median value greater than $200,000, notably higher than the county average of $164,972, and six of these block groups had median property values over $300,000. In comparison, in Cuyahoga County, there are seven census blocks groups of 33 total block groups located outside the park, but within 1 mile from the boundary, that have a median value over $200,000, and 22 block groups with median housing values of less than $150,000.

Similar to Cuyahoga County, median housing values in Summit County in block groups with a boundary that intersects with the park have relatively higher residential property values when compared to those within a mile of the park and in the county overall. In Summit County, 16 of 23 total census block groups whose boundaries intersect with the park report a median residential property value greater than $200,000, and six block groups have median values over $300,000. These median values are considerably higher than the county median housing value of $158,000. In comparison, in Summit County, there are 22 census blocks groups of 64 total block groups located outside the park, but within 1 mile from the boundary, that have a median value over $200,000 and 36 block groups that have median values of less than $150,000. Table 3-14 summarizes the median residential housing values.

Damage to Landscaping

Landscaping can have a substantial impact on property values, enhancing the resale value of a property by up to 15 percent, with a treed lot selling for 7 to 14 percent more than a lot without trees (Nuss 2000). Furthermore, landscaping expenditures are often easily recovered when a property is sold, with 100 to 200 percent of landscaping costs typically recovered (Taylor 2003). Therefore, improvements to landscaping may be seen as a successful way to improve property values.

Unfortunately, deer can often have a highly destructive effect on landscaping. Their diet experiences seasonal variation, which is typically a function of what is available. Browse, which refers to trees, shrubs, and vines, composes a substantial part of the average deer diet. As habitat dwindles due to development pressure and as deer populations grow, deer may turn to surrounding residential areas for food, particularly in late fall, winter, and early spring when other food sources may be scarce.

The average adult deer consumes approximately 6 to 10 pounds of food per day during late spring, summer, and fall (McDonald and Hollingsworth 2007), which may result in increased pressure on surrounding landscaped areas from deer browsing if available natural habitat cannot support the population. In residential areas in or near protected areas such as Cuyahoga Valley National Park, deer often cause virtually year-round damage to landscaping, which can be costly to replace.

TABLE 3-14: MEDIAN RESIDENTIAL HOUSING VALUES, 2000

Area	Median Value for Owner-Occupied Housing	Number of Block Groups
Ohio	$103,700	
Cuyahoga County	$164,972	
Block groups with boundaries located within the park	Over $300,000	6
	Over $200,000	9
	Under $150,000	2
	All Values	13
Block groups located outside the park within 1 mile of park boundary	Over $200,000	7
	Over $300,000	2
	Under $150,000	22
	All Values	33
Summit County	$158,159	
Block groups with boundaries located within the park	Over $300,000	6
	Over $200,000	16
	Under $150,000	5
	All Values	23
Block groups located outside the park within 1 mile of the park boundary	Over $300,000	6
	Over $200,000	22
	Under $150,000	36
	All Values	64

Deer damage shrubs and landscape vegetation by eating the buds, leaves, flowers, and twigs, and by rubbing on the bark of trees. In home gardens, deer often eat leaves, flowers, stems, and/or other edible parts. Other less frequent damage includes trampling of plants and damage to trees and shrubs caused by antler rubbing (West Virginia University 1985). Damage generally extends to an average of 6 feet in height, which is typically as high as a deer can reach.

The ODNR Division of Wildlife collects information on the number of complaints specific to deer damage. From 2005 to 2009, 106 deer damage reports were filed in Cuyahoga County. A high of 25 complaints were filed in 2005 and a low of 14 were filed in 2007. During the same period, 110 complaints were filed in Summit County, with a low of 19 complaints in 2005 and 2006 and a high of 27 in 2009 (ODNR 2010a). The report does not specify the location or type of land use for which such complaints were filed. Therefore, it is not known how many complaints were filed for properties in or near the park. Additionally, information is not available regarding estimated costs associated with deer damage.

Deer Management in Cuyahoga Valley National Park: A Study of Local Residents' Attitudes presents findings from a survey for both residents living in communities directly surrounding the park and residents living more than 5 miles from the park but within the nine-county area surrounding the park. Of those residents who completed the survey and live close to the park, approximately 83.2 percent of respondents indicated that too much damage to shrubs, crops, and gardens would result if no deer management plan were in place. Additionally, 91.2 percent of respondents indicated that reducing deer damage to shrubs, crops, and gardens would be beneficial (Dougherty, Fulton, and Lime 2001).[2]

Damage to Agricultural Crops

Although not nearly as prevalent as residential use, farms are located both within the park and in areas just outside the park boundary. In addition to private farms, the CI Program (see "Section 3.6, Rural Landscapes") has increased the long-term leasing in the park for crop and livestock production. The competing needs of agriculture and wildlife using the same lands often result in conflict. White-tailed deer are thought to be the most common wildlife species that routinely damage agricultural field crops (MacGowan et al. 2006). In Ohio, it has been documented that deer damage fruit, Christmas tree, and nursery crops (Scott and Townsend 1985). The amount of wooded area near a crop field can be an important contributor to the intensity of damage caused by deer (MacGowan et al. 2006). Fragmentation (i.e., patchy arrangement) of wooded habitats may contribute to the frequency of crop damage by deer. Deer thrive in edge habitats—areas where one habitat type intersects another. This type of edge habitat is particularly abundant in the park and areas at the edge of the park.

A 2007 study of agricultural landscapes in national parks found that deer could do considerable damage to agricultural crops, particularly corn, and that they damage crops from emergence to harvest. Deer are thought to cause more damage to corn than other wildlife species (Stewart, McShea, and Piccolo 2007). Another survey of wildlife damage to agricultural lands within the park determined that deer were one of the primary causes of agricultural losses, particularly for sweet and field corn, orchards, and pumpkins (Labovitz 1994).

In and near the park, deer were also consistently observed in hay, oat, clover, and wheat fields, but damage to those crops appeared to be minimal. One local farmer reported losses to Christmas tree and flower crops. One sweet corn farmer employs auditory devices (e.g., corn cannons, tape-recorded owl calls) and live-trapping to deter deer and other wildlife on private lands (Labovitz 1994). Some of the complaints recorded by the ODNR Division of Wildlife (mentioned in the previous section) may be associated with damage caused on agricultural lands, although the report does not specify the type of land use where such activities occurred (ODNR 2010a). Several farmers remove deer each year on private land in the park under nuisance wildlife permits from the State of Ohio.

3.8 VISITOR USE AND EXPERIENCE

Deer and deer management actions can have many effects on visitor use and experience in the park. Of concern are effects on the natural surroundings from overbrowsing, effects of deer removal, and effects on visitors using the park from the various proposed management actions that could cause temporary closures or disturbances.

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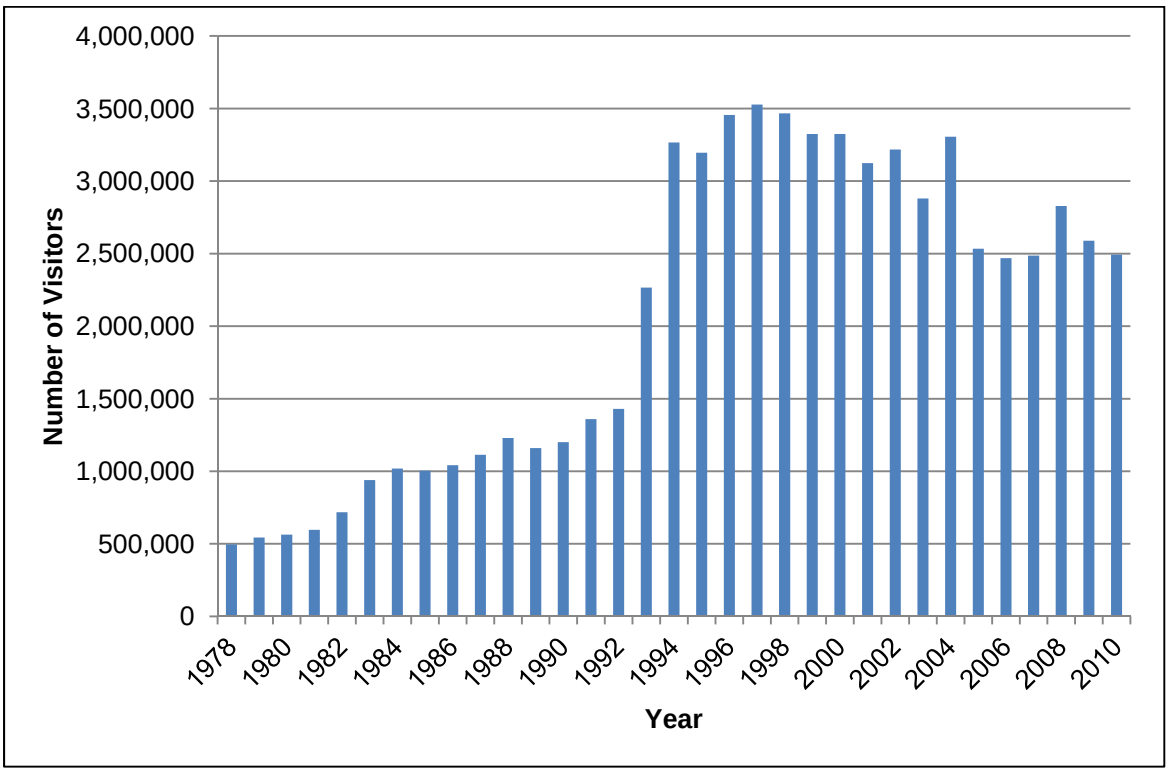
2. The majority of survey respondents were male. Because gender has been shown to be a strong predictor of wildlife attitudes and values, and to account for this bias in response, the research results were weighted for gender to represent the census data of the local population more accurately.

The park has between 2.5 and 3.0 million visitors each year, placing it among the top 15 most visited national parks. The summer months experience the highest visitation rates. Visitors come to the park to use and experience the park in many different ways, but generally, visitors come to engage in recreational activities and experience scenic values.

3.8.1 VISITATION

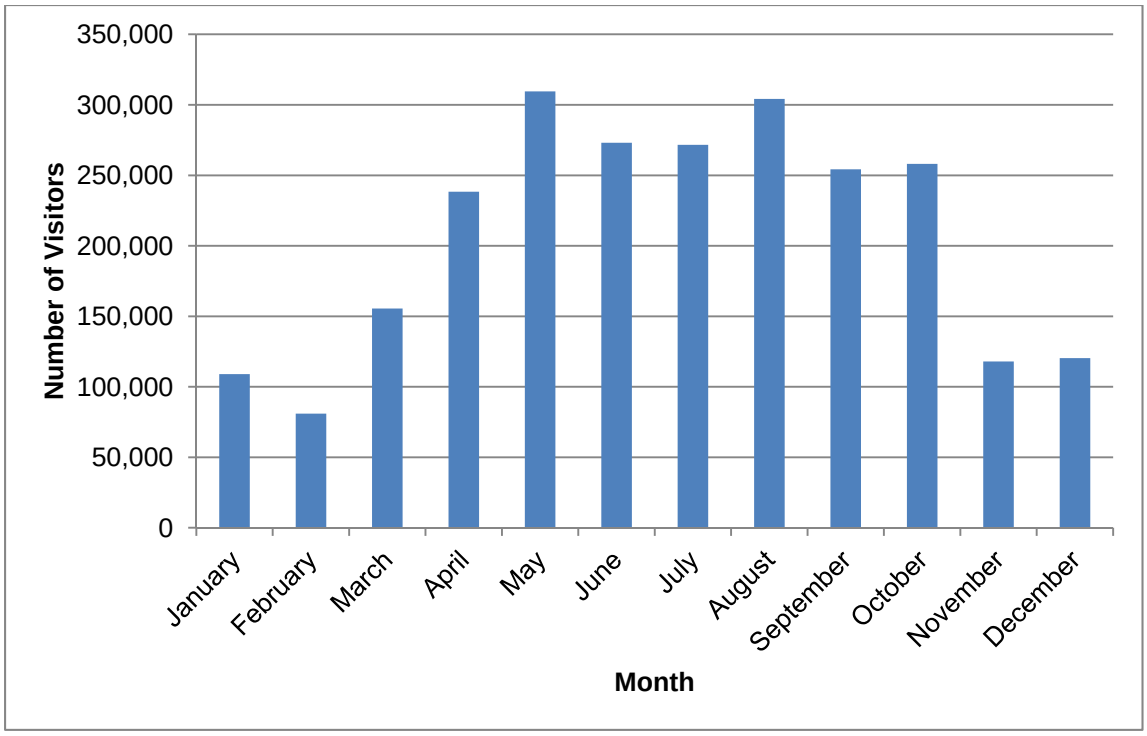
The park lies in a metropolitan area made up of Cleveland and Akron that is home to approximately 3 million people. The abundant scenic resources of the park, within an hour's drive of these cities, make it an attractive destination. Visitors perceive the park to be more remote than it is, probably due to the strong contrast with adjacent developed areas (Schleicher, Anderson, and Lime 1994). While the park area has a long history of heavy human use, there are still abundant natural areas and areas recovering from human impact. The park offers a variety of scenic views and vistas generally not available in the surrounding urban environments.

Visitation has increased steadily since 1978, growing over 500 percent from approximately 0.5 million visitors in 1978 to 2.5 million in 2010 (see Figure 3-11). Visitation jumped from approximately 2.2 million in 1993 to 3.2 million in 1994, and remained above 3 million until decreasing to 2.5 million in 2005 (NPS 2009q). Between the years 2000 and 2010, an average of 2.8 million people visited the park each year, with the highest number of visitors reaching 3.3 million (2000), and the lowest being 2.5 million (2006). The late spring to summer months (May, June, July, and August) experience the highest visitation numbers, while the late fall to winter months (November, December, January, and February) typically experience the lowest visitation (see Figure 3-12).



Source: NPS 2009q.

FIGURE 3-11: ANNUAL PARK VISITATION BY YEAR, 1978–2010



Source: NPS 2009q.

FIGURE 3-12: PARK VISITATION BY MONTH (2010)

3.8.2 VISITOR ACTIVITIES

A visitor study for the park was conducted in 2005 that examined visitor use statistics, trends, and experiences from those visiting the park (Lee, Littlejohn, and Hollenhorst 2006). A total of 1,188 questionnaires were distributed to visitors, and 905 were completed and returned (a 76 percent response rate). The study showed that during the July 23–31, 2005, study period, 91 percent of the visitors were from Ohio, while approximately 1 percent were international visitors (Lee, Littlejohn, and Hollenhorst 2006).

Survey respondents rated which services and facilities in the park they valued the most. Those services and facilities that received ratings of “extremely important” or “very important” (the two highest ratings available) include the Towpath Trail, hiking trails, parking lots, restroom facilities with running water, and bicycle connector trails. Respondents also rated the quality of the services and facilities they used while visiting the park. Those services and facilities that received ratings of “very good” and “good” (the two highest ratings available) include the Towpath Trail, hiking trails, railroad stations, restroom facilities with running water, and parking lots. In addition, the survey respondents were asked to rate the resources/qualities/attributes that brought them to the park. Those resources/qualities/attributes that received ratings of “extremely important” or “very important” were recreational opportunities, scenery, clean air, natural quiet/sounds of nature, and escape from an urban setting (Lee, Littlejohn, and Hollenhorst 2006).

According to the visitor use study, the most common primary reasons for visiting the park were to bicycle (35 percent), hike/walk (26 percent), and jog/run (12 percent). Approximately 2 percent of respondents reported that bird-watching/nature viewing was their primary reason for visiting the park, while 18 percent actually participated in bird-watching/nature viewing while visiting the park. The most common activities included hiking/walking (55 percent), bicycling (47 percent), and taking a scenic drive for

pleasure (33 percent). Most visitor groups who participated in the study (54 percent) spent 2 to 3 hours at the park during their visit (Lee, Littlejohn, and Hollenhorst 2006). Some of the key visitor activities or visitor facilities in the park are described below.

Trail Use

There are 184 miles of trails within the park boundary that provide for biking, hiking, equestrian, and cross-country skiing recreational opportunities. According to the 2005 visitor use study, a majority of park visitors are from Ohio and their primary reason for visiting is the use of the trails (NPS 2010g).

The Ohio & Erie Canal Towpath Trail

Bicycle trails include the Ohio & Erie Canal Towpath Trail, MPSSC Bike & Hike Trail, and Cleveland Metroparks' all-purpose trails in Brecksville and Bedford reservations, as well as all roads and parking lots.

Hiking trails include those designed specifically for hiking only, as well as multi-use and cross-country ski/hiking trails. These range from nearly level to challenging and pass through various habitats, including woodlands, wetlands, and old fields. Horseback riding is permitted in the park only on trails signed and designated as equestrian trails. Horses need to be brought in, as there are no horse rentals adjacent to the bridle trails in the park.

Bird-watching

The park was designated as an Important Bird Area by the Ohio Chapter of the National Audubon Society in 2004 and has long been recognized by bird watchers as an ideal area for observing birds. The great variety of habitats in the park makes it possible to observe more than 200 bird species throughout the year (NPS n.d.f).

Bird watchers

Fishing

Catch-and-release fishing is encouraged at the park to maintain the fish populations needed for continued sportfishing. The Cuyahoga River and numerous ponds are open for fishing. Anglers need to have a State of Ohio fishing license to fish. Eating fish from the river is not recommended because some fish advisories are in effect for the Cuyahoga River. Steelhead trout and bullhead can be caught in the Cuyahoga River. Bluegill, bass, and crappie can be caught in lakes and ponds.

Visitor Contact Facilities

The park has six visitor contact facilities: Canal Visitor Center, Boston Store Visitor Center, Hunt Farm Visitor Information Center, Frazee House, Peninsula Depot Visitor Center, and Cuyahoga Valley Environmental Education Center.

Scenic Railroad

Cuyahoga Valley Scenic Railroad operates regular excursion railroad trips on the historic Valley Railway line throughout the year. Excursions depart from Akron Northside Station, Peninsula Depot, Canal Visitor Center, and Rockside Station. Excursion choices include a round trip through the 33,000-acre Cuyahoga Valley National Park or explorer options where passengers can get off at Canal Visitor Center, the Village of Peninsula, or Akron to visit a separate attraction before returning by rail to their originating station. Other passenger services include Bike Aboard!, The Polar Express™, Thomas the Tank Engine™, Young at Heart, and the Student Explorer Program. Educational audio tours are available on the Cuyahoga Valley Scenic Railroad excursions.

3.8.3 SOCIAL ATTITUDES REGARDING DEER MANAGEMENT

Fulton et al. (2004) used a survey mailed to 1,800 residents living in a nine-county region in northeastern Ohio, which was the primary service area for the park and includes many park visitors, to assess local attitudes toward the deer population and its management. Half the surveys were sent to people living within 6.2 miles (10 kilometers) of the park (termed the “near stratum” in the survey), and half were sent to people living more than 6.2 miles away but within the nine counties closest to the park (the “far stratum”). The survey found that 74 percent of respondents in the near stratum and 63 percent of the respondents in the far stratum who believed that lethal deer control was unacceptable agreed that a lethal deer-control program would make them have a negative opinion of park staff and that they would be emotionally upset by a lethal deer-control program.

The results of this survey indicate that public attitudes toward deer and their management could be influenced by proximity to the park. Some of the difference may lie in the proximity, and therefore the perceived severity of, a deer overpopulation problem (Fulton et al. 2004) (a more detailed summary of the survey is included in “Section 1.7, Scoping Process and Public Participation”).

3.9 VISITOR, EMPLOYEE, AND VOLUNTEER HEALTH AND SAFETY

The NPS is committed to providing appropriate, high-quality opportunities for visitors, employees, and volunteers to enjoy parks in a safe and healthy environment. Through the *First Annual Centennial Strategy for Cuyahoga Valley National Park*, the park has set a goal to “promote a safety and health culture for all employees and visitors” as well as an objective to “reduce the number of employee lost-time incidents and serious visitor injuries by 20 percent” (NPS 2007c).

The primary areas of concern regarding visitor, employee, and volunteer health and safety for deer management planning include the general safety related to implementation of deer management alternatives (especially firearm use), deer/vehicle collisions, and the potential spread of Lyme disease. The GMP (NPS 1977) for the park states that a management objective regarding visitor and employee health and safety is to provide for the safety and protection of visitors, residents, and employees.

3.9.1 GENERAL HEALTH AND SAFETY ISSUES

Park staff are proactive about protecting the safety of both visitors, employees, and volunteers. Park rangers and employees post public notices on bulletin boards around the park and on the park website to ensure that visitors to the park are properly informed regarding safety concerns. The park will produce press releases if a situation requires public notification. For employees, safety tailgate sessions are held regularly during staff meetings to address specific safety topics. The park’s Safety Advisory Council is responsible for administering the safety program of the park, including developing specific safety plans,

coordinating safety inspections, and making safety recommendations to the Superintendent. The park's Board of Survey committee reviews all employee accidents as well as damage or loss of property, and makes recommendations for prevention of future incidents. Table 3-15 shows injury rates for both visitors and employees in recent years.

TABLE 3-15: INJURY DATA FOR RECENT YEARS

Fiscal Year	Number of Visitor Accidents/Sudden Illnesses	Number of Employee Accidents/Sudden Illnesses
2009	45	31
2008	36	32
2007	28	17

Source: NPS 2010e.

A visitor accident or incident is defined as an accidental event affecting any non-NPS employee that results in serious injury or illness requiring medical treatment, or in death. In fiscal year (FY) 2009, a total of 45 visitor accidents/incidents occurred at the park. The majority of these involved bicycling activities (17 of the 45); others included running injuries, falls during hiking/walking, vehicular accidents, and sudden illnesses. Most of the accidents occurred on the Towpath Trail (18 of the 45) and other roads and trails (NPS 2010e). There has been only one incident involving a hunter shooting across the Towpath Trail, which did not result in any accidents or injuries to visitors (or employees) (Petit, pers. comm., 2011b).

All employees are properly trained to do their jobs safely and effectively, and this would include any jobs associated with deer management activities. Most injuries or accidents are usually sustained by maintenance staff and park rangers, who often perform manual work outdoors. In 2009, most injuries occurred in and around buildings and involved falls/slips and lifting/bending injuries (NPS 2010e). No injuries have occurred related to deer management activities performed to date (Petit, pers. comm., 2011b); however, NPS staff would be exposed to additional potential safety risks if deer management activities were added to their work routine.

3.9.2 DEER/VEHICLE COLLISIONS

A safety issue for visitors, employees, and local residents related to this plan involves deer/vehicle collisions. The majority of incidents within the park are a result of vehicle accidents; however, most motor vehicle accidents occur on public roads, not NPS property, and are therefore not reportable to the NPS (NPS 2009r). In 2008, there was one motor vehicle accident reported and the accident was not deer related (NPS 2009r).

Deer/vehicle collisions are a threat to human safety and are one of the predominant sources of deer mortality. In 2009, nearly half (49 percent) of the reported deer crashes in Cuyahoga and Summit counties occurred in the months of October, November, and December, with nearly one-fourth of these (23 percent) in November alone (Ohio Department of Public Safety [ODPS] 2010). These months correspond to when mast production is high and to the deer mating season, which can cause increased movement in deer.

During 1990–1994, deer/vehicle collisions within Cuyahoga and Summit counties in and near the park increased at an annual rate of 16 percent. In more recent years, deer culling efforts around the park in Cuyahoga and Summit counties as well as in nearby communities could account for a decline in the

number of deer/vehicle collisions in and around the park, which decreased from 273 in 2001 to 187 in 2005 (Table 3-16) (ODPS 2006). From 2007 to 2008 there was a 14.8 percent increase in deer/vehicle collisions within Cuyahoga County as a whole, with a total of 459 accidents (Table 3-17) (ODPS 2008, 2009). Summit County saw a 9 percent increase from 2007 to 2008, with 601 accidents throughout the county (ODPS 2008, 2009). In 2008, one employee was involved in a deer/vehicle collision within the park (NPS 2009r).

TABLE 3-16: DEER/VEHICLE COLLISIONS IN AND AROUND THE PARK, 2001–2005

Year	Cuyahoga County	Summit County	Total
2001	111	716	273
2002	476	674	219
2003	525	642	235
2004	485	618	201
2005	478	624	187

Source: ODPS 2006.

Note: Table lists only those deer/vehicle collisions that occurred in and around the park, not total deer/vehicle collisions that occurred within Cuyahoga and Summit counties (see Table 3-17).

TABLE 3-17: DEER/VEHICLE COLLISIONS IN CUYAHOGA AND SUMMIT COUNTIES, 2001–2009

Year	Total	
	Cuyahoga	Summit
2001	509	716
2002	476	674
2003	525	642
2004	485	618
2005	478	624
2006	473	629
2007	400	547
2008	459	601
2009	419	575

Source: ODPS 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010.

3.9.3 LYME DISEASE

One visitor and employee health concern related to deer management is Lyme disease, as indicated in public scoping. Lyme disease is an infection caused by *Borrelia burgdorferi*, a type of bacterium called a spirochete that is carried by deer ticks. A hard tick, *Ixodes scapularis*, which commonly attacks white-tailed deer, is the primary means of transmission for this disease organism. An infected tick can transmit the spirochete to the humans and animals it bites. Since the disease was first recognized and reported in Connecticut in 1975, three areas in the United States have been identified where this disease organism is known to be endemic, or occurring naturally. These are areas of the Northeast (in coastal areas from northern Virginia to southern Maine), the northern Midwest (Minnesota and Wisconsin) and the West (parts of California, Oregon, Utah, and Nevada). Although most cases occur in the northeastern United

States, cases of Lyme disease have been reported in at least 25 states, including Ohio (American Lyme Disease Foundation n.d.).

Between 1984 and 2002, Ohio had 812 cases of Lyme disease, 100 of which occurred in Cuyahoga and Summit counties. During this period, the number of reported cases of Lyme disease in Ohio has varied from a low of a few cases per year to a high of over 100, with the average number of reported cases being 45 (Ohio Department of Health [ODH] 2002). Data from the past 20 years show that about half of Ohio's cases of Lyme disease had no travel history. This indicates that people acquired Lyme disease in Ohio, despite the fact that the tick responsible for the disease is rarely found in Ohio (ODH 2011). From 2000 to 2009, a range of 3 to 8 annual cases were reported in Cuyahoga County, with 8 cases in 2009, and a range of 0 to 5 annual cases were reported for Summit County, with 3 cases reported in 2009 (ODH 2010). In 2008, the two counties had a total of 8 Lyme disease cases, accounting for approximately a fifth of Ohio's 45 total Lyme disease incidences (ODH 2010). The prevalence of Lyme disease within the park is unknown (NPS 2009e).

Conflicting evidence exists to support the link between deer and Lyme disease. A 2005 NPS study at Fire Island National Seashore found that "because deer are not competent reservoirs for the disease organism, they play no direct role in the transmission cycle. Deer are, however, the primary host for the black-legged tick and thus indirectly affect the distribution and abundance of immature ticks" (NPS 2005b). USDA-APHIS, in its environmental assessment on deer damage management in Ohio, suggests a correlation between infected ticks, deer numbers, and Lyme disease cases (USDA-APHIS 2009). The report states, "deer are an important reservoir for Lyme disease and are the primary host for the adult deer tick" (USDA-APHIS 2009). While deer may not be the major agent that transmits the Lyme-disease spirochete to ticks, they do provide a major means of dispersal for the ticks. Ostfeld, Jones, and Wolff (1996) indicate that the distribution of larval deer ticks was determined by the distribution of white-tailed deer during the prior autumn.

3.10 PARK MANAGEMENT AND OPERATIONS

3.10.1 MANAGEMENT OVERVIEW

Deer management actions, even the dissemination of information about deer and their effects on the environment, require time and money, and all alternatives considered would have effects on staffing and operating budgets. The organization of Cuyahoga Valley National Park staff includes the office of the superintendent and five operating divisions: Resource Management; Visitor and Resource Protection; Interpretation, Education and Visitor Services; Maintenance; and Administration. In Fiscal Year 2010 there were 109 full-time equivalent positions (FTE), with a federally appropriated budget of $11,116,930 (Table 3-18).

The permanent staff is augmented by a seasonal or temporary workforce, which varies from year to year and numbered 124 employees in 2010. Typically the seasonal workforce in natural resource management has been associated with exotic plant management, and monitoring of wetlands and water quality. This workforce includes conservation interns through the Student Conservation Association, two to three seasonal employees (mostly student hires) and two to three student interns. In addition, many volunteers assist the park in all functional areas. In 2010, there were 4,086 volunteers, providing 140,850 hours (Petit, pers. comm., 2011g). Many of these provided assistance with exotic plant management, re-vegetation/restoration, and monitoring of vegetation, water quality, wetlands, and wildlife populations (birds, amphibians, reptiles, butterflies, beaver, coyotes, and white-tailed deer). In 2010, volunteers contributed 15,139 hours of time toward natural resource management activities and wildlife interpretation overall (Petit, pers. comm., 2011d).

TABLE 3-18: OPERATING BUDGET BY DIVISION FOR CUYAHOGA VALLEY NATIONAL PARK

Division	Operating Budget (2010)	FTE
Resource Management	$ 1,179,110	10
Visitor & Resource Protection	$ 1,877,850	21
Interpretation, Education & Visitor Services	$ 2,032,777	21
Maintenance	$ 3,722,511	44
Administration	$ 1,222,844	8
Office of the Superintendent	$ 1,083,838	5
Total 2010 Appropriation	$11,116,930	109

Source: Petit, pers. comm., 2011d.

3.10.2 RESOURCE MANAGEMENT DIVISION

Ten FTEs are assigned to management of cultural and natural resources. Three positions (Biologist, Ecologist, and Plant Ecologist) are specifically dedicated to natural resource management. Four other positions (Landscape Architect, Historical Landscape Architect, Civil Engineer, and GIS Specialist) interface with both natural and cultural resource management issues, though they are not substantially involved in deer management. Two positions (Historical Architect, Structural Engineer) focus on cultural resources primarily. The Division Chief currently oversees all deer management activities directly. Natural resource management staff currently devote about 10-15 percent of their time to deer management activities, which include conducting annual fall spotlight surveys, conducting vegetation monitoring, and implementing data management (data entry and data checking) and data analysis. The natural resource management staff also coordinates volunteers to help conduct annual fall spotlight counts and vegetation monitoring.

3.10.3 VISITOR AND RESOURCE PROTECTION DIVISION

The Visitor and Resource Protection Division includes 21 FTE who perform law enforcement functions at Cuyahoga Valley National Park. Eleven permanent FTE and seven seasonal employees possess law enforcement commissions. Their responsibilities include tasks associated with protecting property and resources; investigating violations, complaints, trespass/encroachment, and accidents; conducting search and rescue; and collecting information on cultural or natural resources. In addition to these duties, during deer hunting season, park rangers conduct patrols within the park and conduct door-to-door visits to park neighbors to discourage poachers, and they work with ODNR staff to investigate poaching incidents. Law enforcement rangers also are responsible for euthanizing injured deer and other animals.

3.10.4 INTERPRETATION, EDUCATION, AND VISITOR SERVICES DIVISION

Thirteen staff members conduct interpretive and education activities at Cuyahoga Valley National Park, through programming to the general visiting public, and through K-12 school programming at the Cuyahoga Valley Environmental Education Center. Interpretive staff in deer management disperse general information on deer natural history and ecology and deer management issues within the park, and provide timely and accurate information to the public and others on public meetings and interpretive programs related to deer management and other natural resource topics. Approximately five percent of formal programs that are offered to the public include mention or focus on deer natural history and behavior. This programming includes Student Explorer programs, as well as other wildlife-focused programming. Deer are also a frequent topic for informal visitor contacts and at visitor contact facilities.

Curricula at the Environmental Education Center for both the residential program and day programs include specific focus on the role and ecological impact of deer. One site bulletin has been prepared that focuses on overabundance of deer and the ecological implications, and interpretation of deer biology and natural history is an area of emphasis for an established volunteer group, Wildlife Watchers.

3.10.5 MAINTENANCE DIVISION

Forty-four FTEs staff the Maintenance Division at Cuyahoga Valley National Park. The primary responsibility of the Maintenance Division is to provide for the general upkeep and maintenance of all park buildings, grounds, roads, trails and infrastructure, including oversight of a variety of small to medium construction projects (Petit, pers. comm., 2011b). The staff perform general maintenance tasks that are rarely related to deer management, although some facilities management staff help upon request with tasks such as fence repair for deer exclosures. Any maintenance services provided to construct or maintain large exclosures or other deer management related tasks considered in this plan/EIS would require project funding (Petit, pers. comm., 2011b).

3.10.6 ADMINISTRATION DIVISION

Eight FTE staff the Administration Division; however, none perform tasks specifically related to deer management. The primary responsibility of the division is to provide administrative support to all divisions and functions within the park. Administrative support functions include human resources, budget and finance, procurement and contracting, property management, and information technology management (Petit, pers. comm., 2011b).

3.10.7 OFFICE OF THE SUPERINTENDENT

The Office of the Superintendent is staffed by the Superintendent, Deputy Superintendent, and three staff. The Superintendent and Deputy Superintendent have attended numerous public meetings, provided briefings and briefing statements, and interact on a regular basis with the public, members of local, state and federal government agencies, and state and federal representatives on matters related to deer (Petit, pers. comm., 2011b).

Chapter 4

Environmental Consequences

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

This chapter analyzes the potential consequences of both beneficial and adverse impacts that would result from implementing the alternatives presented in this plan. A summary of laws and policies relevant to each impact topic, definitions of impact intensities (for example, negligible, minor, moderate, and major), methods used to analyze impacts, and the analysis methods used for determining cumulative impacts are also included. As required by CEQ regulations implementing the National Environmental Policy Act (NEPA), a summary of the environmental consequences for each alternative is provided in Table 2-12, which can be found in Chapter 2. The resource topics presented in this chapter, and the organization of the topics, correspond to the resource discussions contained in Chapter 3.

4.1.1 SUMMARY OF LAWS AND POLICIES

Three environmental protection laws and their implementing policies guide the actions of the National Park Service (NPS) in the management of the parks and their resources—the Organic Act of 1916, NEPA and its implementing regulations, and the Omnibus Management Act. For a complete discussion of these and other guiding authorities, refer to "Section 1.9, Related Laws, Policies, Plans, and Constraints" in Chapter 1. These guiding authorities are briefly described below.

The Organic Act of 1916 (16 USC 1), as amended or supplemented, commits the NPS to making informed decisions that perpetuate the conservation and protection of park resources unimpaired for the benefit and enjoyment of future generations. NEPA is implemented through regulations of CEQ (40 CFR Parts 1500–1508). The NPS has, in turn, adopted procedures to comply with these requirements, as found in Director's Order 12 (NPS 2011k) and its accompanying handbook (NPS 2005a). The Omnibus Management Act (16 USC 5901 et seq.) underscores NEPA provisions in that both acts are fundamental to park management decisions. Both acts provide direction for connecting resource management decisions to the analysis of impacts and communicating the impacts of those decisions to the public, using appropriate technical and scientific information. Both acts also recognize that such data may not be readily available, and they provide options for resource impact analysis should this be the case. Section 4.5 of Director's Order 12 adds to this guidance by stating, "when it is not possible to modify alternatives to eliminate an activity with unknown or uncertain potential impacts, and such information is essential to making a well-reasoned decision, the National Park Service will follow the provisions of CEQ regulations (40 CFR 1502.22)." In summary, the NPS must state in an environmental assessment or impact statement (1) whether such information is incomplete or unavailable; (2) the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment; (3) a summary of existing credible scientific adverse impacts that is relevant to evaluating the reasonably foreseeable significant adverse impacts; and (4) an evaluation of such impacts based on theoretical approaches or research methods generally accepted in the scientific community. Collectively, these guiding regulations provide a framework and process for evaluating the impacts of the alternatives considered in this plan/EIS.

4.2 METHODOLOGY FOR ASSESSING IMPACTS

The following elements were used in establishing impact intensity definitions and analyzing the potential effects of the alternatives on each resource category:

- General analysis methods as described in guiding regulations, including the context and duration of environmental effects.
- Basic assumptions used to formulate the specific methods used in this analysis.
- Intensity definitions used to define the level of impact resulting from each alternative.
- Methods used to evaluate the cumulative impacts of each alternative in combination with unrelated factors or actions affecting park resources.

These elements are described in more detail below.

4.2.1 GENERAL ANALYSIS METHODS

The analysis of impacts follows CEQ guidelines and Director's Order 12 procedures and is based on the underlying goal, as stated in Chapter 1 ("Section 1.2, Purpose of and Need for Action"), of supporting forest regeneration and providing for long-term protection, conservation, and restoration of native species and other park resources at Cuyahoga Valley National Park. This analysis incorporates the best available scientific literature applicable to the region and setting, the species being evaluated, and the actions being considered in the alternatives.

As described in "Chapter 1: Purpose of and Need for Action," the NPS created an interdisciplinary science team to provide important input to the impact analysis. For each resource topic addressed in this chapter, the applicable analysis methods are discussed, including assumptions and impact intensity definitions.

4.2.2 ASSUMPTIONS

Several assumptions were made to frame and guide the analysis. These assumptions are described below.

Analysis Period

Goals, objectives, and specific implementation actions needed to manage deer at Cuyahoga Valley National Park are established for the next 15 years; therefore, the analysis period used for assessing impacts is up to 15 years. The impact analysis for each alternative is based on the principles of adaptive management, which would allow the NPS to change management actions as new information emerges from monitoring the results of management actions and ongoing research throughout the life of this plan.

Geographic Area Evaluated (Area of Analysis)

The geographic study area (or area of analysis) for assessment of indirect and direct impacts includes all of the Cuyahoga Valley National Park. The area of analysis for socioeconomics/adjacent lands and for most cumulative impacts was extended to about 1 mile beyond the park boundary to better capture the home range of a deer standing on the park boundary (NPS 2009e). The individual analysis sections all begin with a description of the area of analysis.

Duration and Type of Impacts

Several basic assumptions are used for all impact topics (the terms "impact" and "effect" are used interchangeably throughout this document):

- *Short-term impacts*—Impacts that are temporary and would not have long–lasting effects, generally less than 3 years and usually associated with implementation of management actions.
- *Long-term impacts*—Impacts that would last beyond the time when management actions are taken, generally longer than three years and possibly lasting through the life of the plan, with potentially permanent effects, such as ongoing impacts to park operations or the beneficial effects on vegetation from reduced deer numbers.
- *Direct impacts*—Impacts that would occur as a direct result of deer management actions (e.g., impacts to vegetation from building exclosures or impacts to visitor use during conduct of the selected management action).
- *Indirect impacts*—Impacts that would occur from deer management actions and would occur later in time or farther in distance from the action (e.g., long-term impacts to vegetation as a result of deer population reduction).

Both direct and indirect impacts are addressed in the analysis, although they may not be specifically labeled as such.

Impact Intensity Definitions

Determining impact intensity is a key component in applying NPS *Management Policies* and Director's Order 12. Intensity definitions were developed to provide the reader with an idea of the intensity of a given impact on a specific topic. The impact intensity definition is determined primarily by comparing the effect to a relevant standard based on regulations, scientific literature and research, or best professional judgment. Because definitions of intensity vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this document. Intensity definitions are provided throughout the analysis for negligible, minor, moderate, and major impacts. In all cases, the impact intensity definitions are defined for adverse impacts. Beneficial impacts are addressed qualitatively.

4.2.3 CUMULATIVE IMPACTS ANALYSIS METHODS

The CEQ regulations to implement NEPA require the assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, current, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). As stated in the CEQ handbook, "Considering Cumulative Effects" (CEQ 1997a), cumulative impacts need to be analyzed in terms of the specific resource, ecosystem, and human community being affected and should focus on effects that are truly meaningful. Cumulative impacts are considered for all alternatives, including Alternative A.

The analysis of cumulative impacts was accomplished using four steps:

Step 1—Identify Resources Affected: fully identify resources affected by any of the alternatives.

Step 2—Set Boundaries: identify appropriate spatial and temporal boundaries for each resource.

Step 3—Identify Cumulative Action Scenario: determine which past, current, and reasonably foreseeable future actions to include with each resource. These actions are not only those within or undertaken by the park but also those actions by any entity that have had or will have an effect on the resources impacted by this plan.

Step 4—Cumulative Impact Analysis: summarize impacts of these other actions (x) plus impacts of the proposed action (y), to arrive at the total cumulative impact (z).

Table 4-1 summarizes the past, present, and reasonably foreseeable future actions that are in addition to the deer management actions analyzed in this plan/EIS and that could affect the same resources at the park that could be affected by deer management actions. These cumulative actions comprise the cumulative impact scenario for this EIS and are discussed in more detail below, grouped by type of actions.

Description of Actions Contributing to the Cumulative Impact Scenario

Ongoing Park Operations and Maintenance

Past, present and future actions in the park involve new construction of facilities and trails; maintenance of existing buildings, roads, and trails; and day-to-day operations. This includes routine maintenance along roads, at picnic grounds, trail maintenance, landscape maintenance (mowing and trimming), and volunteer activities (e.g., park cleanups). All of these actions, particularly any new construction, have the potential to affect vegetation and habitat through trampling, direct removal of vegetation where necessary, and habitat fragmentation, albeit on a relatively small scale.

Land Development/Construction Outside the Park (Residential, Commercial, and Transportation Related)

Urban and suburban development around the park grew beginning in the 1950's and continues today. There are 17 political subdivisions in the two counties that encompass or adjoin the park (Summit and Cuyahoga), and these two counties have both seen changes in population over the last decade or two. Between the 1990 and 2000 census, Cuyahoga County saw its population decrease by 1.3 percent (Cuyahoga County Planning Commission n.d.b), and it continued to decrease over the next decade by 8.2 percent (U.S. Census 2011b) Summit County saw a 5.4 percent increase in population from 1990 to 2000 (Cuyahoga County Planning Commission n.d.b), and remained relatively steady over the next decade, with a slight decrease of 0.2 percent from 2000 to 2010 (U.S. Census 2011b). In many ways, the changes in numbers represent a shift in population from urban centers to more rural areas (Meck and Wittenberg 1998). Much of this projected growth is likely to occur in the municipalities surrounding the park. This growth will likely be residential and commercial development, and associated utilities, highways, and rail lines. For example, State Route 8, which borders the eastern edge of the park, has recently been expanded to a multilane restricted access highway (Plona, pers. comm., 2012), and this is spurring proposals for commercial and residential development in the east side of the park (Petit, pers. comm., 2011b). Land development generally involves removal of vegetation, including both clearcutting and selective timbering, which contributes to the reduction and fragmentation of natural habitat in the area surrounding the park.

Agricultural Use

In addition to urban/suburban land development, much of the natural habitat surrounding the park has been converted to agricultural uses over the years and continues to be used for that purpose. This continues to contribute to reduction and fragmentation of natural habitat in the area surrounding the park,

and provides an unnatural food source for deer. However, agricultural areas are decreasing because of increasing suburban development, as described above, and it is anticipated that agricultural use surrounding the park may continue to decrease in the future, although this is dependent on economic conditions (Petit, pers. comm., 2011b).

Visitor Use – Trampling/Social Trails

Visitors using the parks have been known to create social (unofficial) trails where there are no established trails or to wander off-trail. There have also been some law enforcement issues with unauthorized use of mountain bikes and ATVs; park staff enforce the regulations and also rehabilitate disturbed areas. Although this is a fairly minor issue with limited impacts, trampling of vegetation and unauthorized trail use can impact both vegetation including rare species and wildlife habitat and disrupt other visitors at the park.

Land Acquisitions and Easements

There are several potential land acquisitions or easements that could occur in the reasonably foreseeable future. Park management responsibilities for these lands or easements would include monitoring, law enforcement, trail development, and associated environmental compliance, and these additional responsibilities could demand more time or financial support from the park. Acquisition of land could also reduce issues with damage to neighboring property owners' plants and crops.

Vehicle Collisions

As described in Chapter 3, the majority of incidents within the park are a result of vehicle accidents, however, most motor vehicle accidents occur on public roads, not NPS property, and are therefore not reportable to the NPS. Because of heavy use of park and local roadways, wildlife and deer/vehicle collisions are likely to continue within the park.

Deer Management/Removals within Park and Surrounding Entities

Both Cleveland Metroparks and Metro Parks, Serving Summit County (MPSSC) manage the deer herd through sharpshooting on lands they own within the park's authorized boundary. As stated in Chapter 1, "Section 1.6.2, Other Deer Management Efforts, Cleveland Metroparks," removed approximately 3,610 deer between 1998 and 2010, roughly 300 deer a year. MPSSC reports removing 149 deer from their three properties within the national park boundary between 2005 and 2008. This management has helped reduce local deer densities system wide. Cleveland Metroparks has reported that since initiation of the deer culling program, the average deer densities for the two reservations located within the legislative boundary of the park (Brecksville and Bedford) have decreased from 70 deer per square mile (Brecksville) and 110 per square mile (Bedford) in 1997–1998, to 35 per square mile (Brecksville) and 33 per square mile (Bedford) in 2006–2008. Actions of the local metro parks are expected to continue annually for the remainder of the life of this plan, and will aid in the regional reduction of the deer herd.

In addition, five private farmers who have deer damage control permits from Ohio Department of Natural Resources (ODNR) to hunt deer within the park's legislative boundary. Most permits allow 10 deer per year. In addition, the park allows farm lessees on park land to build fences and to use deterrents to protect crop and agricultural land use. These lessees will be increasing in the park, to potentially 1,345 acres of managed federal agriculture in the valley in the next 10 years (NPS 2003).

Public Hunting and Deer Damage Control on Private Property

In addition to the deer management programs described above, public hunting in the state of Ohio includes the hunting of deer on private properties within a mile of the park boundary, which can affect deer populations that also use the park. Although no specific data are available about neighboring lands, ODNR reports deer harvest by county and season, and for Summit County, 559 antlered and 896 antlerless deer were removed by hunting in the 2009–2010 season (ODNR 2011). Deer damage control permits are also issued to private landowners outside the park boundaries, and this action results in the removal of additional deer. These permits are tracked by county, and the number of permits in Summit County have increased from 19 in 2005 to 25 in 2009, with the number of deer removed increasing from 87 in 2007 to 116 in 2009 (ODNR 2011).

Invasive Species/Non-Native Species Management (Inside and Outside Park)

Cuyahoga Valley National Park began a nonnative plant management program in 2003 (NPS 2004a). Sixteen species were identified as the most invasive within the park, invading a broad range of habitats, from forests and meadows to wetlands and disturbed roadsides (NPS n.d.i; see also discussion in Chapter 3). The park has placed emphasis on removing invasive species from wetlands, areas of rare plant populations, and areas where the infestation by invasive species has been relatively low. Management techniques include areas being adopted by local stewards, mechanical removal and the proper use of approved herbicides.

Other neighboring park agencies are also addressing control of invasive species. Cleveland Metroparks created an invasive plant strike team as part of their Invasive Plant Management Program in early 2009. The goal of this six-year capital project is to protect the biological heritage of the Park District by preventing the establishment and spread of invasive plants. This team of seasonal employees is trained to identify target plant species, use herbicides and application equipment safely, keep accurate records for daily treatments, maintain the Weed Information Management System data base, and map the location of invasive species increased in recent years. The invasive plant strike team typically works in targeted areas where native plant biodiversity is most threatened by invasive plants, selecting methods that are safest to adjacent plant populations. Contractors applying herbicides typically work in monoculture areas where invasive plant populations comprise over 80 percent of the total plant population (Cleveland Metroparks 2011). MPSSC sponsors garlic mustard pulls, in which volunteers help remove garlic mustard, an aggressive biennial herb that outcompetes native seedlings, by pulling the plants up by the roots and disposing of them off site.

Plant Pests and Disease

Plant and animal community structure and composition are altered by a variety of pests and diseases in northeast Ohio. Long-term effects of Dutch elm disease and chestnut blight are reflected in the current condition of the park's vegetation and continue today. In 1999 a large gypsy moth (*Lymantria dispar*) outbreak occurred, resulting in 4,372 acres of defoliation in the park. In response, 575 egg mass survey plots were assessed in 1999 to document gypsy moth populations. In 2000, approximately 6,300 acres of park forested federal lands were treated with two applications of *Bacillus thuringiensis* variety *kurstaki* (Btk, a bacterial insecticide that affects the larvae of the gypsy moth and some other butterfly and moth species), and 800 acres were treated with two applications of Gypchek® (a virus-based insecticide that affects only gypsy moth larvae). Although populations were reduced significantly, approximately 400 acres of defoliation still occurred in 2000. The NPS sprayed 326 acres with one application of Btk in 2001. No other treatments have been applied in the park since that time (Skerl, pers. comm., 2011). Some defoliation occurred in 2008 in areas near Brecksville adjacent to the park boundary. Future outbreaks

may require additional treatment as defined in the Gypsy Moth Program Environmental Assessment (NPS 2000a), and the park continues to monitor gypsy moth egg mass density.

Emerald ash borer (*Agrilus planipennis*) is a potential future threat. This beetle from Asia was recently reported (summer 2002) found attacking and killing ash (*Fraxinus* spp.) trees in southern lower Michigan; adjacent Windsor, Canada; and locations in Ohio and Indiana. Current infestations have been detected in most counties surrounding the park and the borer is expected to enter the park in the future. Ash overstory in the park averages 10-20 percent of forest cover.

Animal diseases such as West Nile virus, rabies, and distemper are reflected in the current condition of the park's wildlife. There is an ongoing oral rabies vaccination program that targets raccoons, and there has been a concerted effort across northeastern Ohio to vaccinate for rabies. A programmatic EA was done by USDA-APHIS to address impacts of the disease and the program (Petit, pers. comm., 2011b). The program is expected to stop the forward advance of rabies and reduce the incidence of rabies cases involving wild and domestic animals and rabies exposure to humans (NPS 2006e). CWD in white-tailed deer is a future concern. As of 2011, the closest case of CWD to the park was reported in white-tailed deer in West Virginia, approximately 200 miles from the park boundary. If CWD were to be detected within 60 miles of the park in the future, the NPS would commence with CWD testing including opportunistic and targeted surveillance. If found closer to the park, future actions could include increased sampling or possible deer removal efforts, depending on the plan in place at that time. The ODNR Division of Wildlife conducts surveillance through CWD tests on deer samples collected during the deer gun hunting season and on road-killed deer. An overview of CWD and the NPS's guidance for CWD is presented in Appendix C.

Health and Safety Incidents and Accidents

In addition to deer management related safety issues, there are other incidents that contribute to the health and safety status of visitors and park employees. These include typical falling, tripping, slipping accidents, water hazards along the river and ponds, and rail and road hazards (including vehicle collisions). These are addressed as part of the affected environment and the analysis of direct and indirect impacts and would be expected to continue into the future, albeit at unpredictable levels. In addition, there are also dangers (e.g., stray bullets) associated with hunting outside the park, and on farms within the park operating under deer damage control permits that would be considered a cumulative action. Although there has been one recorded incident related to hunting on private lands within the park boundary (hunter cited for shooting an arrow across a towpath), no accidents have ever been reported related to hunting (Petit, pers. comm., 2011b).

Scientific Research

Cuyahoga Valley National Park sometimes receives applications for research permits to conduct scientific studies in the park, such as research on rare plants. Requests for scientific research studies are processed as received and permit conditions are included to reduce impacts, which are mainly limited to minor effects due to access and trampling. These requests are expected to continue into the future.

TABLE 4-1: CUMULATIVE IMPACT SCENARIO

Impact Topic	Area of Analysis	Past Actions (from 1997 to present)	Current Actions	Future Actions (15 years)
Temporal boundary for all resources is 1997, when neighboring park agencies began culling deer. Spatial boundary is listed for each topic but generally consists of the park and (as appropriate) a 1 mile border surrounding the park boundary that includes the typical home range for deer.				
Vegetation	Up to 1 mile beyond park boundary	• Past deer management (Cleveland Metroparks, MPSSC, state, and the Cuyahoga Valley National Park) • Park operations and maintenance • Land development outside the park (residential, commercial, and transportation)—clearcutting and selective timbering • Agricultural use • Trampling and soil disturbance from visitor use • Park control of invasive species • Pests and diseases- controls and outbreaks (e.g., gypsy moth) Rare species: • Scientific research	Same as past actions, plus: • Neighboring park agencies' control of invasive species	Same as current actions, but also decreasing agricultural use over time and additional suburban development. Plus: Woody Vegetation: • Possible infestations by Emerald ash borer

Impact Topic	Area of Analysis	Past Actions (from 1997 to present)	Current Actions	Future Actions (15 years)
White-tailed Deer	Up to 1 mile beyond park boundary	• Past deer management (Cleveland Metroparks, MPSSC, state, and the Cuyahoga Valley National Park) • Park operations and maintenance • Land development outside the park (residential, commercial, and transportation) • Additional roads/traffic (and associated vehicle collisions) • Exotic plant control • Pests and disease (gypsy moth management) • Hunting • Visitor uses • Scientific research • Additional fencing of farmlands	Same as past actions, plus: • Depredation and crop damage permitted deer removals • Increased development outside park	Same as past actions, plus: • Potential for actions regarding CWD (though NOT currently found in Ohio) and other diseases
Other Wildlife and Wildlife Habitat	Up to 1 mile beyond park boundary	Same as Vegetation, plus: • Diseases (rabies vaccination)	Same as past actions	Same as past actions
Special-status Species	Up to 1 mile beyond park boundary	Same as Vegetation and Other Wildlife and Wildlife Habitat	Same as past actions	Same as past actions
Rural Landscapes	Cuyahoga Valley National Park	• Past deer management (Cleveland Metroparks, MPSSC, state, and the Cuyahoga Valley National Park) • Land development outside the park (residential, commercial, and transportation) • Implementation of the Countryside Initiative Program	Same as past actions	Same as past actions

Impact Topic	Area of Analysis	Past Actions (from 1997 to present)	Current Actions	Future Actions (15 years)
Socioeconomics/ Adjacent Lands	Up to 1 mile beyond park boundary	• Past deer management (Cleveland Metroparks, MPSSC, state, and the Cuyahoga Valley National Park) • Land development outside the park (residential, commercial, and transportation, including rail traffic)	Same as past actions	Same as past actions, plus: Potential land acquisitions or easements
Visitor Use and Experience	Cuyahoga Valley National Park	• Development of scenic railroad and bike trails • Highway development around the park	Same as past actions, plus: • Additional development around the park • New trail plan	Same as current actions, plus: • Increased pressure for other recreational uses
Visitor and Employee Health and Safety	Up to 1 mile beyond park boundary	• Hunting outside the park • Vehicle collisions • Tripping, falling, and slipping hazards associated with daily park employee and visitor activities • Rabies vaccination program	Same as past actions	Same as past actions
Park Management and Operations	Cuyahoga Valley National Park	• Past deer management (Cleveland Metroparks, MPSSC, state, and the Cuyahoga Valley National Park) • Land development outside the park (residential, commercial, and transportation, including rail traffic) • Park management, operations, and maintenance	Same as past actions	Same as past actions, plus: • Potential land acquisitions or easements • Increased pressure for other recreational uses • Implementation of Trail Plan

4.3 IMPACTS ON VEGETATION

4.3.1 GUIDING REGULATIONS AND POLICIES

The NPS Organic Act of 1916 and the NPS *Management Policies 2006* (NPS 2006a) direct parks to provide for the protection of park resources. The *Management Policies 2006* state that "the Service will not attempt to solely preserve individual species (except threatened or endangered species) or individual natural processes; rather, it will try to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and genetic and ecological ecosystems" (NPS 2006a, sec. 4.1). The policies further state, "The Service will not intervene in natural biological or physical processes, except … to restore natural ecosystem functioning that has been disrupted by past or ongoing human activities, or when a park plan has identified the intervention as necessary to protect other park resources, human health and safety, or facilities" (NPS 2006a, sec. 4.1). With regard to the restoration of natural systems, the NPS "will reestablish natural functions and processes in parks" and it "will seek to return such disturbed areas to the natural conditions and processes characteristic of the ecological zone in which the damaged resources are situated" (NPS 2006a, sec. 4.1.5).

The Cuyahoga Valley National Park General Management Plan (NPS 1977) includes the following management policies that pertain to vegetation:

- All national significant natural resources within the park will be preserved, protected, and used in an appropriate manner.
- All specimen trees, groves, forests, remnant stands, and other significant plant communities will be preserved for scientific and interpretive purposes.
- The introduction of exotic plants not already present in the park in significant numbers will be discouraged on federal lands. Exempted communities will be encouraged to preserve stands of native vegetation wherever they occur.

4.3.2 ASSUMPTIONS, METHODOLOGIES, AND INTENSITY DEFINITIONS

Information is presented in Chapter 3 on the types and distribution of vegetation in the park. This information, communications with NPS staff, and past monitoring data were used to identify baseline conditions within the area of analysis. Action thresholds identified for taking management action were based on recent monitoring conducted at the park and research conducted in areas with similar habitat conditions, as well as discussions with the science team. The following impact intensity definitions were developed to include an assessment of impact to both the woody and herbaceous vegetation of the park, using professional judgment and observations of vegetation cover.

Negligible: A reduction in the abundance and diversity of native vegetation may occur, but any change would be so small that it would not be of any measurable or perceptible consequence. Observed seedling density would indicate that very good regeneration was occurring, and observations of the herbaceous indicator species would indicate that browsing is very light or not occurring.

Minor: A reduction in the abundance and diversity of native vegetation would occur and would be measurable, but would be limited and of little consequence to the viability of the native plant community Observed seedling density would represent that fair to good regeneration was occurring, and observations of the herbaceous indicator species would indicate that some browsing is occurring.

Moderate: Some reduction in the abundance and diversity of native vegetation would occur, and it would be measurable, but would result in a small-scale consequence to the viability of the native plant community. Observed seedling density would represent that poor regeneration was occurring, and observations of the herbaceous indicator species would indicate that browsing is affecting a sizeable amount of the herb layer.

Major: A noticeable reduction in the abundance and diversity of native vegetation would occur. The change would be measurable and would result in a possible permanent consequence to the resource. Observed seedling density would represent that little to no regeneration was occurring, and observations of the herbaceous indicator species would indicate that browsing was affecting the majority of the herb layer.

4.3.3 AREA OF ANALYSIS

The area of analysis for impact assessment is the Cuyahoga Valley National Park. The area of analysis for cumulative impacts is the park and the area within one mile of the park boundary, which encompasses typical deer movement outside the park boundary.

4.3.4 IMPACTS OF THE ALTERNATIVES

Alternative A: No Action (Continuation of Existing Management)

Analysis

Under Alternative A, park staff would continue to monitor the deer population and vegetation and continue to use tree tubes or small-scale fencing to protect small areas of restored tree plantings. As described in Chapters 1 and 3, the park has been conducting forest/field exclosure monitoring since 1991. Findings indicate that deer are severely impeding the growth of seedlings in bottomland forests, suppressing the increase of groundcover native diversity in upland forests, decreasing the amount of foliage in forests and fields, and enhancing the diversity and density of groundcover in upland fields. Recent vegetation monitoring of seedlings indicates that open plots are showing a reduction in seedling regeneration. Monitoring of trillium, which was selected by the park as an indicator species for assessing impacts to herbaceous plants, has shown that trillium inside exclosures are able to reach a stem height that allows plants to flower, while those outside do not reach flowering height (see Chapter 3, “Section 3.2.4, Current Vegetation Status and the Role of Deer”). Monitoring of trillium flowering from 1997 to 2010 also shows a stark difference in the number of trillium flowers produced in the exclosures (generally 0 to 3) compared to the open plots (generally near 30 or higher since 2003). Analysis of trillium stem height data in 2010 shows that the percentage of plants less than 5 inches tall by deer management zone were 73 percent in zone 3, 52 percent in zone 4, and 76 percent in zone 5 (Petit, pers. comm., 2012). All of these results exceed the action threshold metric for herbaceous vegetation (i.e., more than 50 percent of the plants have a mean stem heights of less than 5 inches).

Under Alternative A, it is expected that the deer population would continue at high densities in all zones within the park, albeit with yearly fluctuations and differences among the zones. As can be seen from 2010 deer density data, all zones still exceeded 30 deer per square mile, which is the high end of the

desired range, despite numbers having fallen in recent years, which is likely due to deer removal actions taken by surrounding land owners. Zone 5 continues to show a higher density than the other zones; deer densities have historically exceeded 60 deer per square mile in that area of the park. In all zones, it is expected that deer would continue to browse on plants to the extent that seedling densities would remain low and noticeable changes to the abundance and diversity of herbaceous vegetation throughout the area would occur. It is not expected that any periodic deer population declines would be low enough or last long enough for forest regeneration to occur or vegetation to fully recover in any zones as long as deer densities remained above 30 per square mile. Based on these results and the expected high numbers of deer over the life of the plan, Alternative A would have long-term major adverse impacts on vegetation due to the extensive amount of deer browsing that would continue to occur at high deer densities.

The park has fenced woody and some herbaceous plant species to protect them from deer browsing, primarily in planted restoration areas, and protects some trees using tree tubes. This would have long-term beneficial impacts on the plants or areas that were protected by prohibiting deer browsing. However the majority of park vegetation would not be protected or not protected once the fencing is removed. Impacts to vegetation would continue to be adverse, long-term, and major because no measures would be taken to limit or control deer population size or growth under this alternative, and the relatively small amount of fencing or protection would not be sufficient to support forest regeneration in the park.

Monitoring vegetation plots and maintaining fenced areas would result in very limited trampling of vegetation as staff traveled to and around any fenced areas that are not located along trails. However, such impacts would be temporary, as these activities typically take only a few days per year, and the amount of vegetation affected by these actions would be minimal, as they would occur in only a few areas. Therefore, the impact of these activities would be short-term negligible adverse.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions that could impact vegetation in and around the park include actions with both adverse and beneficial impacts on vegetation. Adverse impacts to vegetation have occurred and will continue to occur from increasing urban and suburban development, agricultural use, and transportation projects in the areas surrounding the park, which has resulted in clearcutting, selective timbering, and removal of vegetation in limited areas, causing long-term minor to moderate localized adverse impacts. Visitor use off main trails has had long-term minor localized adverse impacts on vegetation due to trampling of vegetation, and/or spreading of noxious weed seeds, and will continue to do so in the future. Past actions within the park, such as construction of facilities and roads, have resulted in removal of vegetation and have adversely affected forest resources to a minor extent in limited areas. Ongoing park maintenance and operations would have long-term minor adverse impacts on vegetation, limited to the areas affected. Gypsy moths have recently had a large, relatively widespread adverse impact on the deciduous forest, and it is possible that Emerald ash borer would similarly adversely affect ash trees in the future. The park’s efforts to control gypsy moths, and other plant diseases and pests, have reversed some of the adverse effects of pests and would continue to benefit forest resources and their ability to naturally regenerate in the future. The park’s exotic plant management efforts and those of neighboring jurisdictions have had and will continue to have sizeable benefits to native vegetation by controlling and limiting the spread of invasive and non-native species. Scientific research, such as vegetation monitoring, benefits park vegetation by supplying information needed for management decisions, although the use of area for monitoring plots limits natural growth in those areas. Beneficial impacts have resulted from past and current deer management efforts undertaken by neighboring agencies and landowners, which have resulted in reduced deer numbers in and around the park.

The past, present, and reasonably foreseeable future actions described above would result in long-term minor to moderate adverse impacts as well as long-term beneficial impacts, including substantial benefits from the deer management actions taken by neighboring agencies and landowners. These impacts, when combined with the long-term moderate to major impacts of continued pressure on vegetation and the limited natural regeneration expected under Alternative A because of continued deer browsing, would result in overall long-term moderate adverse cumulative impacts on vegetation. The sizeable beneficial impacts from other actions, especially the actions of adjacent landowners to reduce deer density, serve to balance out the adverse effects of Alternative A on a cumulative basis. Alternative A would contribute considerably to the overall adverse cumulative impact because of the expected continued deer browsing that would restrict forest regeneration and adversely affect herbaceous species.

Alternative B: Combined Nonlethal Actions

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative B. In addition, large-scale exclosures would be constructed and rotated for the purposes of forest regeneration. Non-surgical reproductive control would be used to reduce the deer population. Similar to other action alternatives, Alternative B would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Large fenced exclosures would be constructed under Alternative B to allow forest regeneration to occur within enclosed areas of the park that would not be accessible to deer. Approximately 30 exclosures, each encompassing about 23 acres, would be used throughout the park. The exclosures would eliminate deer presence within a total of 700 acres or about 5 percent of the park. Protecting these areas from deer browsing would allow native woody species to grow higher than heights reached by deer (60 inches or 150 centimeters) after about 10 years, at which time the exclosures would be moved, and another 5 percent of the park's vegetation would be enclosed. This action would have a long-term beneficial impact on up to about 10 percent of the woody vegetation in the park after 15 years (the life of the plan): 5 percent inside the existing exclosures at 15 years, and 5 percent in the original exclosures, which has grown above deer reach. However, the effect of having no browsing protection on woody species in the remaining unfenced areas of the park would be similar to Alternative A. It is expected that monitoring over the life of the plan would continue to show that most of the long-term unfenced plots would have low seedling regeneration. Exclosures would provide a long-term beneficial, impact on herbaceous vegetation in about 5 percent of the park at any one time, however, these benefits would be limited to the location and time period of exclosure areas. The restoration planting protections described under Alternative A would continue to be used under Alternative B, proving limited benefits. Although this alternative may show some improvement over that seen under Alternative A from the exclosures, it is expected to result in long-term moderate to major adverse impacts, when viewed over the life of the plan.

Constructing, maintaining, and monitoring the 30 large exclosures would have some impact to the vegetation within the park due to the trampling of small tree seedlings and herbaceous plants and the removal of existing woody vegetation. Even though fences would be located to avoid most trees, some trees would likely need to be removed during construction. Additionally, tree branches within 5 feet of either side of the fence would be removed to avoid branches hitting the fence in high winds or existing dead branches falling on the fence, thus minimizing future maintenance requirements. Given the small size of the affected area of fence construction in relation to the size of the park (about 33,000 acres), and the limited nature of the action, the impact of exclosure construction and maintenance would be negligible. Trampling during fence construction and removal of deer from within fenced areas, as well as during monitoring, would have short-term negligible adverse impacts, because construction and

monitoring would average only a few days per year and affect only a few areas, resulting in very small changes to the vegetation.

For the purposes of this analysis, it is assumed that an acceptable chemical reproductive control agent would be available and feasible during the life of this plan as described in Chapter 2. Implementing reproductive controls would have short-term (a few hours to a few days in any location), localized, and negligible adverse impacts to vegetation. The effect of reproductive control on the deer population and thus deer browsing could be beneficial if the target deer density could be achieved within the life of this plan. However, the time required for the population to be reduced to the extent needed to allow for forest regeneration could be many years; researchers disagree on the amount of time needed to reduce a population size using reproductive controls (Hobbs, Bowden, and Baker 2000; Nielsen, Porter, and Underwood 1997; Rudolph, Porter, and Underwood 2000). The actual amount of time needed to observe a decrease would depend on a number of factors, such as the type of treatment, its effectiveness in stopping reproduction, the size of the population at the time of initial treatment, the actual mortality rate, and the percentage of the population that was treated. Other factors, such as untreated deer moving into the park and treated deer leaving the park, would also influence the time required to achieve reduced numbers.

Numerical reductions of white-tailed deer populations have been achieved with fertility control in at least two instances (Rutberg and Naugle 2008). However, these studies cannot be taken as evidence that fertility control can be used in Cuyahoga Valley National Park to reduce the deer population to the density that will allow the forest to regenerate. These studies focused on a fenced population and a relatively small segment of an intensively managed island population, and both study areas occupied less than one square mile. Also, the reductions achieved in these studies (27 percent over 5 years and 58 percent over 10 years) indicate that the amount of reduction in deer density needed to achieve the desired forest regeneration would take a long time to occur. Therefore, there is no empirical research that supports the conclusion that existing fertility control technology in a free-ranging population contiguous with other deer herds (such as what occurs in Cuyahoga Valley National Park) would have the desired outcome and meet plan objectives in support of forest regeneration. Although it is possible that the deer population goal could be met over a long period of time, the risk of not meeting the goal would be high.

Modeling efforts (Hobbs, Bowden, and Baker 2000; Rudolph, Porter, and Underwood 2000; Merrill, Cooch, and Curtis 2006) and a comparison of field efforts that used lethal (Frost et al. 1997) and non-lethal methods (Rutberg and Naugle 2008) have also shown that fertility control is not as effective or efficient as culling when the goal is to reduce white-tailed deer populations. Hobbs, Bowden, and Baker described a model where if 90 percent of the breeding does in the park were effectively treated annually, mortality would need to exceed the number of surviving offspring from the 10 percent of untreated does to achieve a population reduction. An average mortality rate in urban/suburban deer populations is 10 percent (Hobbs, Bowden, and Baker 2000). Based on these factors, it is expected that reproductive control could stop population growth, but the park would not be able to reach its initial deer density goal within the life of this management plan using current technology. It is recognized that there has been a sizeable decrease in deer density in many zones over the past few years, such that deer densities in all zones except zone 5 are approaching 30 deer per square mile. If this were to continue, treating the remaining deer may eventually decrease the population size to the point where regeneration could occur and impacts to herbaceous vegetation would decrease. However, with the open nature of the population and the uncertainty of success with this method, it is likely that this would not be sufficient to result in a recovery in vegetation within the life of this plan, and moderate to major adverse impacts would continue until the population densities decreased more throughout the park.

Cumulative Impacts

The same past, current, and future actions described under Alternative A would also occur under Alternative B, including long-term minor to moderate adverse effects from increasing urban and suburban development and agricultural use in the areas surrounding the park, visitor use off main trails, construction of facilities and roads, park maintenance, and other cumulative actions, and substantial beneficial impacts from exotic species control and actions taken by neighboring jurisdictions to reduce deer numbers, as well as from scientific research. These impacts, when combined with the mostly long-term moderate to major adverse impacts of Alternative B, would result in overall long-term moderate adverse cumulative impacts to vegetation. The sizeable beneficial impacts from other actions, especially the actions of adjacent landowners to reduce deer density, serve to balance out the adverse effects of Alternative B on a cumulative basis. Alternative B would contribute considerably to the overall adverse cumulative impact because of the lack of immediate reduction in the deer herd and the associated browsing impacts on vegetation.

Alternative C: Lethal Actions (Sharpshooting and Capture/Euthanasia)

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative C. In addition, sharpshooting would be used under this alternative to reduce the deer population, along with capture and euthanasia in circumstances where sharpshooting would not be appropriate. Similar to other action alternatives, Alternative C would include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Under this alternative, the removal of approximately 375 deer annually for four years would be necessary to reach the midpoint of the initial density goal (about 21 deer per square mile). This would occur after the removal is completed in year 4 if the beginning deer population was at 2010 levels, approximately 1,669 deer parkwide. It is expected that rapidly reducing the deer population and associated browsing pressure would allow the number of tree and shrub seedlings to increase and survive to maturity in all areas of the park, providing the necessary growth for natural forest regeneration, and would result in long-term beneficial impacts on herbaceous vegetation, which could regenerate over time with decreased deer browsing. This would be particularly true in zone 5, which still exhibited very high deer density in 2010 (80 per square mile).

The conclusion is supported by the long-term unfenced vegetation plot data from the park. As described under Alternative A, vegetation monitoring results from recent years show a reduction in seedling regeneration in unfenced plots that is attributable to deer browse. As described under Alternative A, trillium monitoring from 1997 to 2010 shows that the average stem height of unbrowsed trillium is below that recommended for reproduction in the open plots in 12 of the 14 years of the study, indicating that browsing was affecting the majority of the herb layer. Monitoring of trillium flowering shows a stark difference in the number of trillium flowers produced in the exclosures compared to the open plots.

Providing rapid deer herd reduction and control would result in beneficial long-term impacts on vegetation because deer browsing would be substantially reduced, especially in higher density zones within the park, which would allow the abundance and diversity of vegetation throughout the park to recover. With more diversity, the vegetation would also be more resilient in the face of any climate change; maintaining and restoring biodiversity in forests promotes resilience to human-induced pressures and is therefore an essential safeguard against expected climate change impacts (Thompson et al. 2009). It is expected that after approximately 10 years, monitoring would show increased seeding regeneration, and

herbaceous plants would recover over varying periods of time. Many plants would recover within a few years, resulting in a long-term beneficial impact to park vegetation.

A number of other actions would occur as part of sharpshooting, as described in more detail in Chapter 2, which would further affect vegetation in limited areas. These actions include setting up bait stations, occupying shooting areas, and dragging deer to locations for processing and transport. Sharpshooting might take place from elevated positions, which would require portable tree stands to be temporarily hung in trees. Such portable stands do not damage the tree (no nails or screws) and would not have an adverse impact to woody vegetation. Removing deer carcasses from the site could require dragging over vegetation, which would temporarily trample some vegetation. All of these actions (bait stations, shooting stations, and dragging deer) would result in some trampling of vegetation; however, the area of impact would be small (less than 1 percent of park vegetation), and because reduction actions would take place during winter months, these actions would not result in any measurable or perceptible change in herbaceous vegetation. The impact of trampling under this alternative would be short-term negligible adverse.

Actions related to the capture and euthanasia of deer, which would generally be used in circumstances where sharpshooting would not be appropriate due to safety concerns (e.g., proximity of nearby residences or other occupied facilities), would be similar to those described for sharpshooting in that deer would be removed from the park through lethal means. The difference would be the way in which deer were captured and euthanized. This method would require physically capturing and handling deer before euthanizing them. Limited trampling would occur with the setting up of traps (rather than setting up bait stations), resulting in short-term negligible adverse impacts. Given that this method could be used at any time of the year, and the number of deer to be removed annually through this method would be low, the waste or carcasses would likely be left on the surface to naturally decompose if the location were sufficiently remote, or would be disposed of in an approved landfill. This would have no noticeable impact on vegetation in the park.

Cumulative Impacts

The same past, current, and reasonably foreseeable future actions described under Alternative A would also occur under Alternative C, with both minor to moderate adverse impacts and beneficial impacts, especially from neighboring deer management actions and invasive species control. These impacts, when combined with the mainly long-term beneficial impacts realized under Alternative C from quickly reducing the park's deer population, would result in a long-term beneficial cumulative impact on vegetation. Alternative C would contribute considerably to the overall beneficial cumulative impact because of the reduction in deer browse damage to woody and herbaceous vegetation.

Alternative D: Combined Lethal and Nonlethal Actions

Analysis

Under Alternative D, lethal reduction would be implemented to reduce the deer population as described under Alternative C. Once the initial density goal were attained, reproductive control (as described in Alternative B) and lethal reduction (if needed) would be used to maintain the deer population at the reduced level. Similar to other all action alternatives, Alternative D would include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

The plant protections and small fenced areas described under Alternative A would continue to be used under Alternative D, but no additional fencing or plant protection use beyond those used for Alternative A would occur under this alternative. As described for Alternative C, under this alternative, the removal of

approximately 375 deer annually for four years and an additional removal of 175 deer prior to beginning reproductive control would be necessary to reach the initial density goal (15–30 deer per square mile) at about 21 deer per square mile. It is expected that rapidly reducing the deer browsing pressure (e.g., dropping from about 80 deer per square mile in zone 5 (2010 density) to about 20 deer per square mile), the number of tree and shrub seedlings would increase, and the number of seedlings surviving to sapling stage would also increase, providing the necessary growth for natural forest regeneration. Herbaceous vegetation would also be able to recover, with many species expected to recover within a few years. Providing immediate reduction and control of the deer population would result in long-term beneficial impacts on vegetation, because deer browsing would be substantially reduced and the abundance and diversity of vegetation throughout the park could recover.

As described for Alternative C, a number of other actions would occur as part of implementing sharpshooting, such as setting up bait stations, occupying shooting areas, and dragging deer carcasses to locations for processing and transport. All of these actions would result in some trampling of mostly woody vegetation; however, the area of impact would be small (less than 1 percent of vegetation), resulting in short-term negligible impacts given the small size of the affected area and the short duration of the impact. As forest regeneration increased, more woody stems might be affected by each action; however, the overall amount of vegetation affected would still be small, and the impact would be short-term and negligible. Herbaceous plants would not be present during many of the winter months planned for sharpshooting.

The actions related to capture and euthanasia could result in trampling of vegetation because of setting up traps (rather than setting up bait stations), with short-term negligible adverse impacts. Reproductive controls would be implemented after direct reduction efforts had initially reduced the population size to the initial deer density goal. Through reproductive control, deer numbers could be maintained at the density goal and impacts on vegetation would be long-term and beneficial.

Some of the actions involved in implementing reproductive control (similar to implementing constructing fences and sharpshooting) could result in trampling of vegetation; however, these actions would last only a few hours to a few days in any location, resulting in negligible adverse impacts on vegetation. Assuming reproductive controls could be used at a parkwide level to maintain the deer population size, impacts on vegetation would be beneficial and long-term because a substantial reduction in deer browsing would allow the abundance and diversity of vegetation throughout the park to recover.

Cumulative Impacts

Cumulative impacts would be essentially the same as described for Alternative C. Past, current and reasonably foreseeable future actions that would contribute to cumulative impacts to vegetation would be the same as those described under Alternative A, with minor to moderate adverse impacts and also beneficial impacts. These impacts, when combined with the mainly long-term beneficial impacts of the reduced deer population under Alternative D, would result in long-term beneficial cumulative impacts on vegetation. Alternative D would contribute considerably to the overall beneficial cumulative impact because of the reduction in deer browse damage to both woody and herbaceous vegetation.

4.3.5 CONCLUSION

Alternative A would result in long-term moderate to major adverse impacts because browsing pressure would be expected to remain high in either all or a large portion of the park throughout the life of this plan (15 years). Similar results would occur under Alternative B because reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Therefore, it is expected that the deer

population would remain at relatively high density levels in the park throughout the life of the plan. Also, the exclosures would protect only a small portion of the forest at any one time, requiring 10 years for regrowth above the browse line. Alternative B would result in long-term moderate to major adverse impacts, with short-term negligible impacts from deer management implementation actions such as placement of bait piles and trampling. For both alternatives, the overall cumulative impact would be long-term, moderate, and adverse, with Alternatives A and B contributing considerably to the adverse cumulative impact on vegetation.

The overall impact to vegetation under Alternatives C and D would be long-term and beneficial because the relatively rapid deer herd reduction would allow the abundance and diversity of vegetation throughout the park to recover. There would be short-term negligible impacts (mainly trampling) from deer management implementation actions. For both alternatives, the overall cumulative impact would be long-term and beneficial, with Alternatives C and D contributing considerably to the beneficial cumulative impact on vegetation.

4.4 IMPACTS ON WHITE-TAILED DEER

4.4.1 GUIDING REGULATIONS AND POLICIES

The NPS Organic Act of 1916, NPS *Management Policies 2006* (NPS 2006a), and NPS *Reference Manual 77: Natural Resource Management* (NPS 2009k) direct NPS managers to provide for the protection of park resources. The Organic Act requires that wildlife be conserved unimpaired for future generations, which has been interpreted to mean that native animal life are to be protected and perpetuated as part of the park unit's natural ecosystem. Parks rely on natural processes to control populations of native species to the greatest extent possible; otherwise they are protected from harvest, harassment, or harm by human activities. The NPS *Management Policies 2006* make restoration of native species a high priority. Management goals for wildlife include maintaining components and processes of naturally evolving park ecosystems, including natural abundance, diversity, and ecological integrity of plants and animals (NPS 2006a, sec 4.1).

4.4.2 ASSUMPTIONS, METHODOLOGIES, AND INTENSITY DEFINITIONS

The evaluation of deer was based primarily on a qualitative assessment of how expected changes to park vegetation (as a result of increased or decreased browsing pressure) would affect the deer population and its associated habitat. The evaluation also considered potential impacts to the deer population directly associated with implementation of the alternatives (e.g., change in daily movements to avoid sharpshooting). Intensity definitions for white-tailed deer were developed based on available information and research on demographics, condition, population dynamics, behavior, and disease in white-tailed deer.

Data on demographic factors such as sex ratio, age structure, and abundance are collected by natural resource managers and are used in modeling wildlife population dynamics. The dynamics of a population are determined by demographic factors and factors such as productivity, survival, harvest rate/mortality rate, and rate of population growth. These, in turn, are directly influenced by deer condition and indirectly by habitat quality (e.g., quality and quantity of available forage). Lastly, deer behavior and risk of disease occurrence and amplification are influenced by all the above.

It is important to note that impacts to deer, as with other wildlife, are analyzed in terms of the desired conditions for the deer population as a whole, including its overall health and ability to function in as natural a condition as possible. Thus, destruction of individual animals and reduction of the herd size

alone are not necessarily adverse impacts, if their effect is to improve the overall condition of the deer population as part of the natural ecosystem.

Available information on the deer population (demographics, conditions, population dynamics, behavior, and disease) was compiled and analyzed in relation to the management actions. The definitions for the intensity of impact are defined as follows:

Negligible: There would be no observable or measurable impacts on the deer population (e.g., demographics, population dynamics, condition, behavior, disease risk) as a result of changes in habitat or directly related to implementation of the management action. Impacts would be well within natural fluctuations, and the differences between natural fluctuations and effects resulting from the actions would not be discernible.

Minor: Impacts would be detectable but would not be outside the natural range of variability. Small changes to the deer population (e.g., demographics, population dynamics, condition, behavior, disease risk) might occur. Occasional responses to disturbance by some individuals could be expected but without interference to factors affecting population levels. Sufficient habitat would remain functional to maintain viability of the deer population.

Moderate: Impacts on the deer population (e.g., demographics, population dynamics, condition, behavior, disease risk) could be outside the natural range of variability. Changes in deer abundance, survival, productivity, movements and other factors would occur, but the deer population would remain stable and viable. Frequent responses to disturbance by some individuals could be expected, with some adverse impacts on factors affecting population levels. Sufficient habitat would remain functional to maintain the viability of the deer population.

Major: Impacts on the deer population (e.g., demographics, population dynamics, condition, behavior, disease risk) would be detectable, would be expected to be outside the natural range of variability, and would be extensive. Changes in deer abundance, survival, productivity, movements and other factors may be large, potentially resulting in decreased viability or stability. Frequent responses to disturbance by some individuals would be expected, with adverse impacts on factors negatively affecting population levels. Loss of habitat would affect the viability of the deer population.

4.4.3 AREA OF ANALYSIS

The area of analysis for assessment of impacts is Cuyahoga Valley National Park. The area of analysis for cumulative impacts is the park and the area within 1 mile of the park boundary, which encompasses typical deer movement outside the park boundary.

4.4.4 IMPACTS OF THE ALTERNATIVES

Alternative A: No Action (Continuation of Existing Management)

Analysis

Under Alternative A, park staff would continue to monitor the deer population and vegetation and continue to use tree tubes or small-scale fencing to protect small areas of restored tree plantings.

As detailed in “Section 4.3, Impacts on Vegetation,” it is expected that the deer population would continue at high densities in many areas of the park (albeit with yearly fluctuations), especially in zone 5, where deer densities have historically exceeded about 60 deer per square mile. High deer density and continuation of excessive browse pressure under Alternative A would further decrease the quality and quantity of available forage; this could result in increased nutritional stress and ultimately, decreased physical condition within the deer herd over the long term. Although little scientific evidence exists to suggest the deer at Cuyahoga Valley National Park are not in good condition, long-term trends in antler beam diameters of yearling bucks and body weight suggest a gradual but substantial decline in herd condition throughout Ohio over the previous two decades (see “Section 3.3, White-tailed Deer) (ODNR 2005c). High density deer populations that have reached or exceeded the ability of the natural environment to support them are at increased risk for disease and substantial losses due to malnutrition and parasitism, particularly during harsh winters, as has already occurred within the park. High deer density populations would also increase the potential for the spread of CWD, if the disease should occur near the park in the future (Joly et al. 2006; Samuel et al. 2003). Additionally, the probability of early detection would be low as the park would not conduct CWD surveillance under this alternative. Therefore, the impacts of Alternative A on deer condition and the risk of disease amplification and likelihood of spread, if CWD should occur, would be long-term, moderate, and adverse.

Starvation and poor reproduction demonstrated by deer in overpopulated herds is not evidence that the herd is regulating itself. Starvation and disease are not acute mortality factors, such as predation, but rather provide only chronic control over a population (Eve 1981). Under these conditions, deer herds can remain at high levels for many years until starvation, disease, or severe winter weather cause a reduction in population size typically lasting two to five years. By this time, adverse ecological effects can already have occurred. Such reductions in the deer herd, as a result of natural die-offs, probably would not allow recovery of the natural community (Warren 1991). Deer in poor physical condition may also experience higher mortality rates because they are more susceptible to deer-vehicle collisions and winter starvation and have an increased rate of fawn abandonment (Beier 1987). Therefore, impacts of Alternative A on deer population dynamics (deer density, productivity, mortality) would be long-term, moderate, and adverse.

It is expected that continued high deer densities under Alternative A would continue to result in the degradation of habitat and loss of food sources. A decrease in the quality and quantity of available forage may also influence deer movements and overall home range size. Generally, the size of a deer’s home range varies with deer density, sex, landscape conditions, and season of the year (Sanderson 1966; Harestad and Bunnell 1979; Loft, Menke, and Burton 1984; PGC 2003). As described in “Section 3.3, White-tailed Deer,” there are currently no specific data on the home range of white-tailed deer within the park. However, it is expected that the average home range of deer within the park is similar to other exurban deer populations (Petit, pers. comm., 2011c), such as those described by Storm et al. (2007)—less than 0.3 square miles—and Etter et al. (2002)—0.2 to 0.35 square miles. Based on these studies, it is likely that the home range of deer at the park is relatively small compared to what is considered a normal home range for white-tailed deer (0.5 to 2 square miles) (Orndorff n.d.; ODNR n.d.a), possibly reflecting the diversity of forage types at the park (e.g., forest, field, residential, wetland). However, it is unknown how long habitat in the park will be able to sustain this population. As vegetative cover in the park forests continues to be adversely affected by overbrowsing, deer would be expected to travel further in search of quality forage and/or may rely more heavily on residential and agricultural landscapes surrounding the park that are constantly replenished. This would result in increased size of deer home range and increased movements across the park boundary into the surrounding community. If forest vegetation continues to decline, deer may also shift their movements relative to use of habitat, resulting in increased reliance on meadows and residential/agricultural areas versus forested habitat. Therefore, impacts on deer behavior (movements, habitat use) are expected to be long-term, minor to moderate, and adverse under Alternative A.

Increases in deer movements may result as park staff travel to and from monitoring plots, install and maintain fencing, and conduct deer counts. Deer population monitoring involves the use of a spotlight from a vehicle along roadways. These activities may occasionally disturb deer and cause temporary change in deer movements. Vegetation monitoring is only conducted three or four times (approximately once every 2 weeks) annually from mid-April to the end of May, and the areal extent of the exclosures, tree tubes, and small-scale fencing is relatively small. Overall it is expected the impacts of these actions on the deer population would be short-term, negligible, and adverse.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions that could impact white-tailed deer in and around the park include several actions with both adverse and beneficial impacts. Impacts on deer from vehicle collisions and hunting, as well as disturbances from traffic and visitor use (including off-trail users and social trails), would continue to have long-term minor adverse impacts by displacing deer and potentially causing some mortality. Although wildlife diseases do not appear to be affecting deer at this time, the potential for these diseases, especially those like CWD and EHD that could affect deer populations, could also contribute to long-term adverse impacts on deer. Deer management plans and programs of neighboring agencies and landowners also contribute to long-term beneficial effects at a population level by helping to maintain lower deer densities. However, these programs, as well as additional fencing of farmland that has occurred, may actually cause deer to move into the park, thereby contributing to park deer population growth and associated effects of browsing on the degradation of deer habitat.

Actions resulting in cumulative impacts to deer habitat would be similar to those described for vegetation, since vegetation comprises the habitat that affects deer to a great extent. Urban development in the areas surrounding the park that result in encroachment into park lands and removal of vegetation that provides deer habitat in limited areas have caused, and will continue to cause, long-term minor to moderate localized adverse impacts. Past actions within the park, such as construction of facilities and roads, have resulted in removal of vegetation and adversely affected forest resources that support deer to a minor extent in limited areas. Gypsy moths have recently had a large, relatively widespread adverse impact on the deciduous forest, and it is possible that Emerald ash borer would similarly adversely affect ash trees in the future. The park’s efforts to control gypsy moths and other plant diseases and pests have reversed some of the adverse effects of pests and would continue to benefit deer habitat and the ability of forest resources to naturally regenerate in the future. The park’s exotic plant management efforts and those of neighboring jurisdictions have had benefits and will continue to benefit in the long term by removing plants that compete with native species. Continued park maintenance operations would have long-term minor adverse impacts on edge habitat for deer, limited to the areas affected. Any off-trail visitor uses affect deer habitat to some extent, but particular activities like horseback riding, dog walking, and hiking can lead to more social trails and spread of exotic weed seeds. Scientific research benefits park vegetation and deer habitats by supplying information needed for management decisions, but even the use of an area for research plots limits natural growth in those areas.

The past, present, and reasonably foreseeable future actions described above would result in long-term minor to moderate adverse impacts and long-term beneficial impacts on white-tailed deer. These impacts, when combined with the mainly long-term minor to moderate adverse impacts under Alternative A from the continued reduction of native habitat, would result in long-term minor to moderate adverse cumulative impacts to the white-tailed deer population. Alternative A would contribute considerably to the overall adverse cumulative impact because of the lack of reduction in the deer herd and the associated browsing impacts on deer habitat.

Alternative B: Combined Nonlethal Actions

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative B. In addition, large-scale exclosures would be constructed and rotated for the purposes of forest regeneration. Non-surgical reproductive control would be used to reduce the deer population. Similar to other action alternatives, Alternative B would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Use of large-scale exclosures would protect some deer habitat, but would eliminate deer presence within a total of 700 acres or about 5 percent of the park. Areas outside the exclosures would continue to be affected by heavy deer browsing, which would have effects similar to those discussed under Alternative A, including the degradation of habitat and loss of food sources. As a result, there would be long-term moderate adverse impacts on deer habitat and associated adverse impacts on the deer population.

If successfully implemented, the use of reproductive control when feasible (see Chapter 2), would help reduce the impact on deer by gradually decreasing their numbers and allowing habitat to improve over time. As previously described in “Section 4.3, Impacts on Vegetation,” the use of reproductive control could reduce the deer population to a limited extent if it was successfully implemented, but this would require many years to actually reduce the population, based on modeling efforts (Hobbs, Bowden, and Baker 2000; Rudolph, Porter, and Underwood 2000; Merrill, Cooch, and Curtis 2006) as well as a comparison of field efforts that used lethal (Frost et al. 1997) and non-lethal methods (Rutberg and Naugle 2008). A number of factors may influence the efficacy and reduction period of this method, including the amount of immigration/emigration of deer to/from the park, mortality and recruitment rates, the size of the population at the time of initial treatment, and the percentage of the population treated. Other factors, such as untreated deer moving into the park and treated deer leaving the park, would also affect the time required to reduce herd numbers. The benefit of this action would be proportional to the amount of population reduction that it provided; therefore, a benefit could not actually be established until an improvement in vegetation and deer habitat was observed. Based on these factors, it is expected that reproductive controls could stop population growth, but would not reduce the numbers of deer to the desired deer density goal within the life of this management plan using current technology. Therefore, impacts to deer habitat and deer would only slightly be offset by this alternative, resulting in long-term minor to moderate adverse impacts. Although there would be benefits over the longer term as a result of reducing population growth; minor to moderate adverse impacts would result from continued habitat degradation that would be expected over the life of the plan. Also, continued high deer densities could increase the risk for disease and substantial losses due to malnutrition and parasitism, contributing to the long-term adverse impacts on deer condition.

With regard to CWD, the probability of spread, if CWD would occur within the park, would be high due to the expected continued high deer density. However, there would be a greater chance of early detection given that the park would initiate opportunistic CWD surveillance under this alternative and targeted surveillance if a case of CWD was confirmed within 60 miles of the park. Therefore, the impacts of Alternative B on the risk of disease amplification and likelihood of spread, if CWD should occur, would be long-term, minor to moderate, and adverse.

The intensity of long-term effects of implementing reproductive control on a free ranging deer herd is difficult to predict given the many variables. The actual administration of the reproductive control would result in disproportional impacts to does versus bucks. The effect on individual deer may be considered a significant adverse impact (i.e., some mortality could occur), due to tranquilizer use and handling stress

on the doe (DeNicola and Swihart 1997; Kilpatrick, Spohr, and DeNicola 1997); generally a 2 to 5 percent mortality rate would be expected. Additionally, there are potential physiological or behavioral changes associated with the application of a chemical reproductive control agent. However, it expected that the long-term adverse effect on the population would be minor to moderate, as the adverse impacts over time would be offset by the beneficial effect of population reduction.

Until reproductive control could be effectively implemented, white-tailed deer density would be expected to remain high, especially in certain areas of the park such as zone 5, potentially resulting in an increase in size of the deer home range and increased movements across the park boundary into the surrounding community as described under Alternative A. A shift in habitat use may also result as vegetative cover in the park forests continues to decrease. Therefore, impacts of Alternative B on deer behavior (movements, habitat use) are expected to be similar to those described for Alternative A, long-term minor to moderate adverse.

Although this alternative would require additional vegetation monitoring plots, the impacts would be similar to those described under Alternative A due the relatively small size of these plots. Increases in deer movements may result as park staff travel to and from monitoring plots, install and maintain rotational and small-scale fencing, conduct deer counts, and administer reproductive control agents. Installation of rotational fencing across 5 percent of the forested area of the park may cause temporary displacement of deer from small areas of the park for up to one month. As described for Alternative A, deer population monitoring involves use of a spotlight from a vehicle along roadways. Administration of reproductive control agents will require capture, handling, and marking of deer. These activities may occasionally disturb deer and cause a temporary change in deer movements. However, these activities would be conducted during short periods of time over a relatively small area at any one time. Given the likely small size of the impacted area and the limited nature of the actions, the impacts of these activities on the deer population would be short-term, negligible to minor, adverse.

Changes in deer movement may also result from the use of bait piles. The bait piles would attract the deer to specific locations, therefore altering their normal movement patterns. However, the use of bait piles would be limited to the months in which the reproductive controls are administered. The impacts of bait piles to deer movement would be short-term negligible adverse.

The construction of the exclosures and reproduction control activities would result in disturbance similar to ongoing park construction and maintenance activities. Therefore, impacts would be limited to the temporary displacement/disturbance of deer as a result of the noise and human presence associated with these activities. As a result, the impacts on the deer population would be short-term negligible adverse.

Cumulative Impacts

The same past, present, and reasonably foreseeable future actions described under Alternative A would also occur under Alternative B, with long-term minor to moderate adverse and long-term beneficial impacts on white-tailed deer. These impacts, when combined with the long-term minor to moderate and short-term negligible to minor adverse impacts of Alternative B from continued reduction of native habitat and deer management actions, would result in long-term minor to moderate adverse cumulative impacts to white-tailed deer. Alternative B would contribute considerably to the overall adverse cumulative impact because of the lack of reduction in the deer herd and the associated browsing impacts on deer habitat.

Alternative C: Lethal Actions (Sharpshooting and Capture/Euthanasia)

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative C. In addition, sharpshooting would be used under this alternative to reduce the deer population, along with capture and euthanasia in circumstances where sharpshooting would not be appropriate. Similar to other action alternatives, Alternative C would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Reducing deer density levels and maintaining these levels would allow vegetation to recover, providing better foraging habitat for deer in the park in the long term. Adverse impacts would still range from minor to moderate during the short term while habitat recovered. However, with increased vegetation and improved foraging habitat, Alternative C would have long-term beneficial effects, and the current adverse impacts to deer and their habitat would be reduced to negligible or minor over the long term as the deer density goal is achieved throughout the park.

This alternative would result in an impact to the deer population size, reducing the population from approximately 31 to 80 deer per square mile (2010), depending on the zone, to approximately 22 deer per square mile within 4 years. As of 2010, management zones 1 and 4 (see Chapter 1, Figure 1-2) have deer density estimates that are relatively close to the maximum deer density goal of 30 deer per square mile, and zones 2 and 3 are at about 36-37 deer per square mile. Therefore, reduction of deer density in these zones is expected to occur fairly quickly upon implementation of Alternative C. However, the deer density estimate for zone 5 is substantially higher than the deer density goal at 80 deer per square mile. Reduction efforts would likely be focused on this zone or others that have higher densities at the time the plan is implemented, and it would take longer to reach the deer density goal in these areas compared to other zones within the park. Research indicates that when habitat is stressed it cannot support healthy deer over the long term (Eve 1981). When deer density is high, signs of nutritional stress, such as low body and internal organ mass, low fecal nitrogen levels, and high prevalence of parasitic infections, typically occur. As discussed in Chapter 3, “Section 3.3, White-tailed Deer,” studies regarding herd health were conducted for the park, demonstrating that, although health of the heard was generally good, the deer population exceeded the habitat carrying capacity (USGS 2000, 2001). As a result, fawn mortality could be expected during extreme winter stress if the habitat quality and deer populations remain at current levels. When deer density is reduced to the nutritional carrying capacity, all of these indicators show improved conditions (Sams et al. 1998). As described in “Chapter 2: Alternatives,” 15 to 30 deer per square mile is more closely aligned with levels that are in balance with other components of the ecosystem, namely a regenerating forest system. Therefore, reducing the population to within this range would have a beneficial effect on the long-term viability of the deer population within the park by minimizing the potential for nutritional stress and disease, and improving habitat.

With regard to CWD, there would be more opportunities to conduct opportunistic surveillance given the number of deer removed under this alternative, which could lead to a greater probability of early detection of the disease. If CWD were to occur within the park, the probability of spread under Alternative C would be lower than Alternatives A and B due to the lower deer densities. Therefore, impacts of Alternative C on the risk of disease and amplification and likelihood of spread, if CWD should occur, would be long-term minor adverse.

As described for Alternative B, changes in deer movement may result as park staff travel to and from monitoring plots, install and maintain rotational and small-scale fencing, and conduct deer counts. Changes in deer movement may also result from the use of bait piles, which would attract the deer to

specific locations; therefore, temporarily altering their normal movement patterns. However, these activities are conducted during short periods of time over a relatively small area at any one time, resulting in short-term negligible adverse impacts to deer behavior (e.g., movement).

Sharpshooting and euthanasia activities may affect the remaining deer herd due to the disturbance and noise associated with the action. Noise impacts (as discussed in Chapter 1) would be minimal due to use of noise suppressors, and impacts of sharpshooting on the remaining deer herd would be limited mainly to the temporary displacement/disturbance of deer during the nighttime hours of the fall and winter months. Therefore, impacts of noise related to sharpshooting and euthanasia to the deer population would be short-term negligible adverse.

Cumulative Impacts

The same past, present, and reasonably foreseeable future actions described under Alternative A would also occur under Alternative C, with long-term minor to moderate adverse and long-term beneficial impacts on white-tailed deer due. These impacts, when combined with the primarily long-term beneficial impacts of Alternative C and the long and short-term negligible adverse impacts of deer management actions, would result in long-term beneficial cumulative impacts to white-tailed deer. Alternative C would contribute considerably to the overall beneficial cumulative impact because of the reduction in browse damage to deer habitat.

Alternative D: Combined Lethal and Nonlethal Actions

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative D. Lethal reduction would be implemented to reduce the deer population as described under Alternative C. Once the initial density goal is attained, reproductive control (as described in Alternative B) and lethal reduction (if needed) would be used to maintain the deer population at the reduced level. Similar to other all action alternatives, Alternative D would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

As with Alternative C, the intent of this alternative would be to rapidly reduce the deer density within the park, especially in zones with the highest deer densities, to allow for the native vegetation to recover from deer browsing pressure. Impacts to the deer population would range from minor to moderate adverse while habitat recovered; however, as vegetation regenerates, better foraging habitat would be provided for the deer in the park.

Reproductive control would be used to maintain deer at a density that would further encourage forest regeneration and improvement of habitat for deer. Although some adverse impacts to the deer condition would continue to occur until the initial deer density goal is reached, reducing the population would have a beneficial effect on the long-term viability of the deer population within the park by minimizing the potential for nutritional stress and disease.

With regard to CWD surveillance, there may be fewer opportunities under Alternative D than Alternative C during the population maintenance phase because reproductive controls would primarily be used for population maintenance instead of lethal actions. However, even though fewer deer may be tested under Alternative D, CWD detection and monitoring would result in long-term benefits for the deer population. If CWD were to occur within the park, the probability of spread under Alternative D would be lower than Alternatives A and B due to the lower deer densities. Therefore, impacts of Alternative D on the risk of

disease and amplification and likelihood of spread, if CWD should occur, would be long-term minor adverse.

As described for Alternative B, the intensity of long-term effects of implementing reproductive control on a free ranging deer herd is difficult to predict given the many variables. The actual administration of the reproductive control would result in disproportional impacts to does versus bucks. The effect on individual deer may be considered a significant adverse impact (i.e., some mortality could occur), due to tranquilizer use and handling stress on the doe (DeNicola and Swihart 1997; Kilpatrick, Spohr, and DeNicola 1997); generally a 2 to 5 percent mortality rate would be expected. Additionally, there are potential physiological or behavioral changes associated with the application of a chemical reproductive control agent. However, it is expected that the long-term adverse effect on the population would be minor to moderate, as the adverse impacts over time would be offset by the beneficial effect of population reduction.

Similar to Alternative C, this alternative would result in an impact to the deer population size, reducing the population from approximately 31 to 80 deer per square mile (2010), depending on the zone, to approximately 22 deer per square mile within 4 years. As of 2010, management zones 1 and 4 (see Chapter 1, Figure 1-2) have deer density estimates that are relatively close to the maximum deer density goal of 30 deer per square mile, and zones 2 and 3 are at about 36-37 deer per square mile. Therefore, reduction of deer density in these zones is expected to occur fairly quickly upon implementation of Alternative C. However, the deer density estimate for zone 5 is substantially higher than the deer density goal at 80 deer per square mile. Reduction efforts would likely be focused on this zone or others that have higher densities at the time the plan is implemented, and it would take longer to reach the deer density goal in these areas compared to other zones within the park. Research indicates that when habitat is stressed it cannot support healthy deer over the long term (Eve 1981). As described for Alternative C, reduction of the deer population size would minimize the potential for nutritional stress and result in a deer density more closely aligned with levels that are in balance with other components of the ecosystem, namely a regenerating forest system. Therefore, reducing the population to this level would have a beneficial effect on the long-term viability of the deer population within the park.

As described for Alternatives B and C, changes in deer movement may result as park staff travel to and from monitoring plots, install and maintain rotational and small-scale fencing, conduct deer counts, and administer reproductive control agents. Changes in deer movement may also result from the use of bait piles, which would attract the deer to specific locations; therefore, temporarily altering their normal movement patterns. However, these activities are conducted during short periods of time over a relatively small area at any one time resulting in short-term negligible adverse impacts to deer behavior (e.g., movement).

Cumulative Impacts

The same past, present, and reasonably foreseeable future actions described under Alternative A would also occur under Alternative D, with long-term minor to moderate adverse and long-term beneficial impacts on white-tailed deer. These impacts, when combined with the primarily long-term beneficial impacts of Alternative D and the long and short-term negligible adverse impacts of deer management actions, would result in long-term beneficial cumulative impacts to white-tailed deer. Alternative D would contribute considerably to the overall beneficial cumulative impact because of the reduction in browse damage to deer habitat.

4.4.5 CONCLUSION

Under Alternative A, deer would experience long-term, minor to moderate, adverse impacts because browsing pressure would likely remain high in either all or a major portion of the park throughout the life of this plan (15 years). There would be short-term negligible impacts from deer monitoring actions, and long-term moderate adverse impacts potentially from CWD (greater potential for spread with higher deer density). The same overall results would occur under Alternative B, long-term minor to moderate adverse impacts, because reproductive control would result in a gradual reduction in the deer population, and consequently the deer population would remain at relatively high levels throughout the life of the plan, especially in areas that far exceed the desired deer density such as zone 5. The exclosures would protect only a small portion of the forest at any one time, requiring 10 years for regrowth above the browse line. Impacts related to the potential spread of CWD would be long-term, minor to moderate, and adverse. For both alternatives, the overall cumulative impact would be long-term, minor to moderate adverse, with Alternatives A and B contributing considerably to the adverse cumulative impact on the white-tailed deer population.

The overall impact to white-tailed deer under Alternatives C and D would be long-term and beneficial because the relatively rapid deer herd reduction would allow the abundance and diversity of vegetation throughout the park to recover and better protect deer habitat. There would be long-term minor adverse effects potentially from CWD and short-term negligible adverse effects from implementing deer management actions (noise, disturbance). For both alternatives, the overall cumulative impact would be long-term and beneficial, with actions under Alternatives C and D contributing considerable benefits to the cumulative impact on the white-tailed deer population.

4.5 IMPACTS ON OTHER WILDLIFE AND WILDLIFE HABITAT

4.5.1 GUIDING REGULATIONS AND POLICIES

The NPS Organic Act of 1916, NPS *Management Policies 2006* (NPS 2006a), and NPS *Reference Manual 77: Natural Resource Management* (NPS 2009k) direct NPS managers to provide for the protection of park resources. The Organic Act requires that wildlife be conserved unimpaired for future generations, which has been interpreted to mean that native animal life are to be protected and perpetuated as part of a park unit's natural ecosystem. Parks rely on natural processes to control populations of native species to the greatest extent possible; otherwise, they are protected from harvest, harassment, or harm by human activities. The NPS *Management Policies 2006* make restoration of native species a high priority. Management goals for wildlife include maintaining components and processes of naturally evolving park ecosystems, including natural abundance, diversity, and ecological integrity of plants and animals (NPS 2006a, sec. 4.1). Policies in the NPS *Natural Resource Management Guideline* state, "the National Park Service will seek to perpetuate the native animal life as part of the natural ecosystem of parks" and that "native animal populations will be protected against…destruction…or harm through human actions."

Cuyahoga Valley National Park's General Management Plan (NPS 1977) includes the following management policies that pertain to wildlife and wildlife habitat; many of these address the vegetation communities that support wildlife:

- All nationally significant natural resources within the park will be preserved, protected, and utilized in an appropriate manner.
- All specimen trees, groves, forests, remnant stands, and other significant plant communities will be preserved for scientific and interpretive purposes.

- The introduction of exotic plants not already present in the park in significant numbers will be discouraged on federal lands. Exempted communities will be encouraged to preserve stands of native vegetation wherever they occur.

4.5.2 ASSUMPTIONS, METHODOLOGIES, AND INTENSITY DEFINITIONS

The evaluation of other wildlife was based on a qualitative assessment of how expected changes to park vegetation (as a result of increased or decreased deer browsing pressure) would affect the habitat of other wildlife. The park's wildlife species are directly affected by the natural abundance, biodiversity, and the ecological integrity of the vegetation that comprises their habitat.

Available information on known wildlife species was compiled and analyzed in relation to the management actions. The definitions for the intensity of an impact to wildlife are defined as follows:

Negligible: There would be no observable or measurable impacts on the abundance and diversity of native species and/or the quality of their habitat

Minor: Impacts would be detectable, but would not be outside the natural range of variability. Small changes to population numbers, number of species present, habitat quality, and other factors might occur. Occasional responses to disturbance by some individuals could be expected, but without interference to factors affecting population levels.

Moderate: Impacts on the abundance and diversity of native species and/or the quality of their habitat would be detectable and could be outside the natural range of variability. Changes to population numbers, number of species present, habitat quality, and other factors would occur, but species would remain stable and viable. Frequent responses to disturbance by some individuals could be expected, with some negative impacts on factors affecting population levels. Sufficient habitat would remain functional to maintain the viability of all native species.

Major: Impacts on the abundance and diversity of native species and/or the quality of their habitat would be detectable, would be expected to be outside the natural range of variability, and would be extensive. For example, population numbers, number of species present, habitat quality, genetic variation, and other metrics might experience large declines. Frequent responses to disturbance by some individuals would be expected, with negative impacts on factors resulting in a decrease in population levels. Loss of habitat might affect the viability of at least some native species.

4.5.3 AREA OF ANALYSIS

The area of analysis for assessment of impacts is Cuyahoga Valley National Park. The area of analysis for cumulative impacts is the park and the area within 1 mile of the park boundary, which encompasses typical deer movement outside the park boundary.

4.5.4 IMPACTS OF THE ALTERNATIVES

Alternative A: No Action (Continuation of Existing Management)

Analysis

Under Alternative A, park staff would continue to monitor the deer population and vegetation and continue to use tree tubes or small-scale fencing to protect small areas of restored tree plantings.

The vegetation/habitat conditions described in "Chapter 3: Affected Environment," for both vegetation and other wildlife and wildlife habitat indicates that deer have already affected the vegetation, and thus habitat, for other wildlife species within the park. The herbaceous and woody seedling layers of the forest have been heavily browsed by deer, suggesting that the abundance and diversity of other wildlife using this understory habitat today is less than what it would be if deer browsing pressure was lower. The songbird study investigating the effects of white-tailed deer on forest understory birds that was conducted within the park shows that high amounts of deer browsing of understory vegetation has led to a reduction in abundance of understory bird species (Petit 1998). McShea and Rappole (2000) found that avian species composition changes as the understory recovers from a period of extended deer browsing. This study is applicable to Cuyahoga Valley National Park because it was conducted at Shenandoah National Park, another NPS unit that does not manage deer populations. The study documented the statistically significant increase of low forest guild birds as the understory recovered from excessive deer browsing. This included several species that nest at Cuyahoga (ovenbird [*Seiurus aurocapillus*], eastern towhee [*Pipilo erythrothalmus*], veery [*Catharus fuscesens*], and wood thrush [*Hylocichla mustelina*]). Heavy deer browsing also degrades habitat and results in a lack of cover for small mammals, making them vulnerable to predation from hawks, owls, foxes, skunks, raccoons, and coyotes. For example, Flowerdew and Ellwood (2001) suggested that deer have indirectly decreased bank vole (*Myodes glareolus*) populations by removing the bramble blackberry (*Rubus fruticosus*) that provides most of its hiding cover (Bates, pers. comm., 2008a).

At continued high densities, deer would also compete directly with other wildlife species for available resources. The production of acorns and other tree nuts, also known as mast, is a critical food source for many small mammals, birds, and deer preparing for the winter season. Particularly during low mast production years, abundant deer populations may directly compete with other wildlife for this important resource. Reduction in the availability of this critical food source negatively impacts reproduction and over-winter survival of species such as the eastern chipmunk (*Tamias striatus*), gray squirrel (*Sciurus carolinensis*), and white-footed mouse (*Peromyscus leucopus*) (Martin, Zim, and Nelson 1951; Miller and Getz 1977; Gashwiler 1979; Ostfeld, Jones, and Wolff 1996; Brooks and Healy 1988; McShea and Rappole 1992; McShea and Schwede 1993; McShea and Rappole 1997; McShea 2000). These impacts may be particularly important to insects such as butterflies, which are often dependent on a very narrow range of host plants (Strong, Lawton, and Southwood 1984; Stewart 2001) that are also preferred deer browse species. Removal of nectar plants and other host species from fields and forests may result in adverse effects on species from the park which are dependent on them. Other species that have a more diverse diet or that spend more time in the upper forest canopy (versus the shrub/ground layer) or leaf litter (e.g., salamanders) would be less affected by continued high deer density in unfenced areas of the park.

Species that use deer as a food source, such as coyotes, could benefit from high deer density or open understory conditions. Other animals may also feed on deer carcasses, like crows (*Corvus* spp.) and raccoons, and these could benefit from higher deer densities. Small predators, such as foxes and hawks, could also benefit from a more open understory because prey might be easier to find. However, if the habitat of the prey species deteriorated to the point where prey (mice, rabbits, ground-nesting birds) could

no longer maintain viable populations within the park, then predator species would also decline. Grassland nesting birds would also benefit from deer browsing that keeps woody plants from taking over grasslands.

Deer impacts to herpetofauna (reptiles and amphibians) and invertebrates have not been well studied. At Cuyahoga Valley National Park, Greenwald, Petit, and Waite (2008) placed coverboards within and outside of deer exclosures and found higher numbers of redback salamanders (*Plethodon cinereus*), and slugs outside of the exclosures. One theory for this result was that soils outside of the exclosures had more nutrients that came from deer droppings and that this attracted the salamanders and snails, in turn attracting the garter snakes that feed on salamanders and slugs. The authors also theorized that given the lack of vegetative cover outside of the exclosures, the coverboards were serving as a refuge for the salamanders and slugs. Given the small sample size (12 paired plots) and different theories for the results, more research is needed. The authors also noted that redback salamanders and garter snakes are species that do well in disturbed habitats. Species that favor undisturbed habitats were not found outside of the exclosures.

Species that depend primarily on other habitats would be less affected by high deer numbers. Some frogs, snakes, salamanders, and turtles (e.g., bullfrogs, northern water snakes, snapping turtles) live in or near water during much of their lives and are therefore less affected by deer. Similarly, heavy deer browsing would not directly change fish habitat, as noted in Chapter 1.

Increases in wildlife movements may result as park staff travel to and from monitoring plots, install and maintain fencing and conduct deer counts. Deer population monitoring involves use of a spotlight from a vehicle along roadways and trails through the park. This activity will be conducted at night and in the fall. No disturbance to breeding or diurnal animals occurs under this activity. However, these activities may occasionally disturb common species of nocturnal wildlife such as raccoons and owls. Additionally, these activities would be expected to occur only periodically (annually to every five years) and for short duration (hours to days). Therefore, it is expected the impacts of these actions on wildlife species would be adverse, long-term, and negligible.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions that could impact wildlife and wildlife habitat would be similar to those described for vegetation, since vegetation comprises the habitat that affects wildlife species to a great extent. Minor to moderate short- and long-term adverse impacts on wildlife are expected from development within the vicinity of the park, including transportation and construction projects. Past actions within and around the park, such as residential development, agriculture, and the spread of invasive exotic species, have adversely affected wildlife and their habitat, with short- and long-term minor to moderate adverse impacts from disturbance, noise, habitat removal and fragmentation, and demise of preferred native plant species. Disease has also affected some species directly (e.g., rabies); however, the rabies control program is providing long-term benefits. The park's exotic plant management efforts would also benefit wildlife habitat in the long term by removing plants that compete with native species. Beneficial impacts have resulted from past and current deer management efforts undertaken by neighboring agencies and landowners, which have reduced deer numbers in and around the park and helped to limit browsing impacts on understory and herbaceous plants that are important habitat for many species.

The past, present, and reasonably foreseeable future actions described above would result in short- and long-term negligible to moderate adverse impacts as well as long-term beneficial impacts. These impacts, when combined with the negligible to potentially major impacts of continued pressure on woody and herbaceous vegetation that makes up the wildlife habitat and the limited natural regeneration expected

under Alternative A because of continued deer browsing, would result in cumulative impacts that would be adverse, long-term, and minor to potentially major depending on the species. Alternative A would contribute considerably to the overall adverse cumulative impact because of the expected continued deer browsing that would adversely affect wildlife food and cover.

Alternative B: Combined Nonlethal Actions

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative B. In addition, large-scale exclosures would be constructed and rotated for the purposes of forest regeneration. Non-surgical reproductive control would be used to reduce the deer population. Similar to other action alternatives, Alternative B would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Large, fenced exclosures would be constructed to allow forest regeneration within localized areas of the park. As explained previously in this chapter in "Section 4.3, Impacts on Vegetation," approximately 5 percent (700 acres) of the park would be protected from deer browsing in this manner at a given time. The size of the openings in the fence (3 to 4 inches square) would allow small birds, mammals, and reptiles and amphibians (e.g., songbirds, squirrels, raccoons, snakes, salamanders) to pass in and out of these exclosures; other small to medium animals would be expected to be able to climb over (e.g., raccoon, opossum) or burrow under (e.g., fox, groundhog) the fencing. The added fence posts and fence would also provide perches for some birds, including hawks and owls. The fence could be an obstacle to others (e.g., birds hitting the fence). This action would make more ground/shrub layer habitat available to other wildlife than Alternative A. However, because only 5 percent of the park would be fenced off from browsing deer at any one time, and because deer density outside the protected areas would be expected to remain high for many years (see following discussion), the beneficial impact to other wildlife would be limited.

The use of reproductive controls could help reduce the impact on other wildlife by reducing the effects of deer browsing on wildlife habitat. However, as previously described in "Section 4.3, Impacts on Vegetation," the use of reproductive control could reduce the deer population to a limited extent if it was successfully implemented, but this would require many years to actually reduce the population, based on modeling efforts (Hobbs, Bowden, and Baker; Rudolph, Porter, and Underwood 2000; Merrill, Cooch, and Curtis 2006) as well as a comparison of field efforts that used lethal (Frost et al. 1997) and non-lethal methods (Rutberg and Naugle 2008). The actual amount of time needed to observe a decrease would depend on a number of factors, such as the type of treatment used, its effectiveness in stopping reproduction, the size of the population at the time of initial treatment, the actual mortality rate, and the percentage of the population treated. Other factors, such as untreated deer moving into the park and treated deer leaving the park, would also affect the time required to reduce herd numbers. The benefit of this action would be proportional to the amount of population reduction that it achieved, and a corresponding improvement to understory habitat. Based on these factors, it is expected that reproductive controls could stop population growth, but it would not be possible to achieve the desired deer density goals for the park during the life of this management plan, at least in the zones with the highest deer densities.

Similar to Alternative A, a continued high deer density and the associated browsing throughout a large portion of the park would reduce the availability of food for species that depend on woodland ground/shrub layer vegetation for survival. These species, including ground and/or shrub-nesting birds (e.g., ovenbirds, veery, and hooded warbler), would decline over time, with adverse, long-term, moderate

to potentially major impacts. Other species that have a more diverse diet (e.g., raccoons) or that spend more time in other habitat (e.g., salamanders and snakes, grassland birds) or the upper canopy (e.g., owls and raptors) versus the ground/shrub layer, would be less affected by or could benefit from high or increased deer density. As with Alternative A, species that use deer or their carcasses as a food source, such as coyotes and crows, and small predators, such as foxes and hawks, could also benefit from the high deer densities that result in a more open understory. As a result, the overall impact to wildlife throughout the park would continue to be long-term negligible to potentially major adverse, depending on the species.

Human presence associated with the installation of fenced exclosures or the reproductive control techniques could adversely affect wildlife while the actions are being carried out. However, such small areas of the park would be affected for a short period that the adverse impact would be short-term and negligible. Bait could provide a beneficial food source to other wildlife during the time that reduction activities were conducted; however, the small quantity and short time periods that bait would be available would have a negligible impact on any species.

Cumulative Impacts

The same past, current, and future actions described under Alternative A would also occur under Alternative B, with long-term minor to moderate adverse impacts from development and other actions and beneficial impacts mainly from control of invasive species and deer management by neighboring jurisdictions that have helped reduce loss of habitat in the area of analysis These impacts, when combined with the long-term negligible to potentially major adverse impacts of Alternative B, would result in cumulative impacts that would be adverse, long-term, and minor to potentially major depending on the species. Alternative B would contribute considerably to the overall adverse cumulative impacts, because the exclosures and reproductive control actions taken would not be expected result in a population reduction to the desired deer density goal in many areas of the park within the life of this management plan, and would not protect wildlife species enough to offset the adverse effects of the continued high deer density expected.

Alternative C: Lethal Actions (Sharpshooting and Capture/Euthanasia)

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative C. In addition, sharpshooting would be used under this alternative to reduce the deer population, along with capture and euthanasia in circumstances where sharpshooting would not be appropriate. Similar to other action alternatives, Alternative C would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Unlike Alternative A, a reduced degree of deer browsing throughout the majority of the park and especially in the zones with very high deer densities, would benefit species that use the same food sources (e.g., acorns), or otherwise depend on ground/shrub layer vegetation for their food and cover. Reduction of deer density would release plant communities from heavy browse pressure and substantially improve the quality and quantity of wildlife habitat parkwide, but especially in the zones with the highest deer density. As the forest herbaceous and shrub layers return and forests experience successful regeneration, wildlife communities would be provided with more high quality forage and nesting sites for ground and shrub nesting bird species and increased wildlife cover. This would lead to increased reproductive success and higher survival for many wildlife species. Under Alternative C, wildlife would be expected to improve in both diversity and abundance, a long-term beneficial impact. Other species that have a more

diverse diet (e.g., raccoons) or that spend more time in other habitat (e.g., frogs and salamanders) or the upper canopy (e.g., barred owls and woodpeckers) would be less affected by a reduced deer density, although a long-term benefit to upper canopy species would be gained in the future as forest regeneration maintained the upper canopy.

Predators that use deer as a food source (such as coyotes) and grassland nesting birds could be somewhat adversely affected by a lower deer density or succession of grassland toward forest. Other animals that feed on deer carcasses, such as crows and raccoons, could also be adversely affected. However, none of these species solely depend on deer as a food source, so the adverse impacts to these species would be long-term and minor at most. Predators could find a denser understory more difficult for hunting small prey than the current open condition, but better habitat conditions and an increase in the abundance of prey species could also benefit these predators.

Wildlife, other than deer, would be temporarily disturbed by the presence of humans placing bait stations, shooting deer, setting traps, and observing deer behavior. Bait could provide a beneficial food source to other wildlife during the time that reduction activities were conducted; however, the small quantity and short time periods that bait would be available would have a negligible impact on any species. The surface disposal of deer waste and/or carcasses would provide a beneficial food source to scavengers like the coyotes, crows, and raccoons; however, under this alternative, it is expected that meat would be donated to the maximum extent possible or would be disposed of through an approved landfill. The small number of carcasses left for natural decomposition would not be substantially different than what occurs through natural mortality (e.g., disease, old age, car collisions). These human disturbances in each instance would result in long-term negligible adverse impacts as they would not cause any measurable change to the habitat or responses by other wildlife species.

Cumulative Impacts

The same past, current, and future actions described under Alternative A would also occur under Alternative C, with, with long-term minor to moderate adverse impacts from development and other actions and beneficial impacts mainly from control of invasive species and deer management by neighboring jurisdictions that have helped reduce loss of habitat in the area of analysis. These impacts, when combined with the long-term beneficial impacts and short-term negligible to long-term minor adverse impacts of Alternative C, would provide long-term beneficial impacts on other wildlife. Alternative C would contribute considerably to the overall beneficial cumulative impacts because deer browsing pressure would be reduced through a rapid reduction of the deer population and this would allow a greater proportion of the forest to regenerate within a few years for herbaceous species to 10 years for woody species, improving habitat for many other wildlife.

Alternative D: Combined Lethal and Nonlethal Actions

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative D. Lethal reduction would be implemented to reduce the deer population as described under Alternative C. Once the initial density goal is attained, reproductive control (as described in Alternative B) and lethal reduction (if needed) would be used to maintain the deer population at the reduced level. Similar to other all action alternatives, Alternative D would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Similar to Alternative C, a reduced degree of deer browsing throughout the majority of the park and especially in the zones with very high deer densities would benefit species that use the same food sources (e.g., acorns), or otherwise depend on ground/shrub layer vegetation for their food and cover. Reduction of deer density would release plant communities from heavy browse pressure and substantially improve the quality and quantity of wildlife habitat parkwide, but especially in the zones with the highest deer density. As the forest herbaceous and shrub layers return and forests experience successful regeneration, wildlife communities would be provided with more high quality forage and nesting sites for ground and shrub nesting bird species and increased wildlife cover. This would lead to increased reproductive success and higher survival for many wildlife species. Under Alternative D, wildlife would be expected to improve in both diversity and abundance, a long-term beneficial impact. Other species that have a more diverse diet (e.g., raccoons) or that spend more time in other habitat (e.g., frogs and salamanders) or the upper canopy (e.g., barred owls and woodpeckers) would be less affected by a reduced deer density, although a long-term benefit to upper canopy species would be gained in the future as forest regeneration maintained the upper canopy.

Also similar to Alternative C, predators that use deer as a food source, such as coyotes, could be somewhat adversely affected by a lower deer density or succession of grassland toward forest. Other animals that feed on deer carcasses, such as crows and raccoons, could also be adversely affected. However, none of these species solely depend on deer as a food source, so the adverse impacts to these species would be long-term and minor at most. Predators could find a denser understory more difficult for hunting small prey than the current open condition, but better habitat conditions and an increase in the abundance of prey species could also benefit these predators.

Wildlife other than deer would be temporarily disturbed by the presence of humans placing bait stations, shooting deer, setting traps, implementing reproductive control techniques, and observing deer behavior, similar to Alternative C. Bait could provide a beneficial food source to other wildlife during the time that reduction activities were conducted; however, the small quantity and short time periods that bait would be available would have a negligible impact on any species. Surface disposal of deer waste and/or carcasses would provide a beneficial food source to scavengers; however, under this alternative, it is expected that meat would be donated to the maximum extent possible or would be disposed of through an approved landfill. The small number of carcasses left for natural decomposition would not be substantially different than what occurs today through natural mortality (e.g., disease, old age, car collisions). These human disturbances in each instance would be adverse, temporary, and negligible, as they would not cause any measurable change to the habitat or responses by other wildlife species.

Long-term reduction and controls on deer population growth would allow vegetation used as food and cover by other wildlife to become more abundant. Therefore, the impact of Alternative D to other wildlife would be mostly beneficial and long-term, depending on the species, and existing adverse impacts would be reduced to negligible or minor levels. The impacts of each method (sharpshooting, euthanasia, or reproductive control) on other wildlife would be essentially the same, as long as habitat was improved by reducing deer browsing pressure. Potential differences in impacts would relate to the time required for implementation and the resulting deer population size.

Cumulative Impacts

The same past, current, and future actions described under Alternative A would also occur under Alternative D, with, with long-term minor to moderate adverse impacts from development and other actions and beneficial impacts mainly from control of invasive species and deer management by neighboring jurisdictions that have helped reduce loss of habitat in the area of analysis. These impacts, when combined with the long-term beneficial impacts and short-term negligible to long-term minor adverse impacts of Alternative D, would provide long-term beneficial impacts on other wildlife.

Alternative D would contribute considerably to the overall beneficial cumulative impacts because deer browsing pressure would be reduced through a rapid reduction of the deer population and this would allow a greater proportion of the forest to regenerate within a few years for herbaceous species to 10 years for woody species, improving habitat for many other wildlife.

4.5.5 CONCLUSION

Under Alternatives A and B, other wildlife would experience primarily adverse, long-term, and negligible to potentially major impacts, depending on the species. Species that depend on ground cover and young tree seedlings or understory shrubs for food or cover could be severely reduced or eliminated from the park, while impacts on species that depend primarily on other habitats (not woodlands) or on the upper canopy for food and cover would be negligible. Alternatives A and B are expected to result in long-term moderate adverse cumulative impacts on wildlife and wildlife habitat. Overall, the long-term reduction and controls on deer population growth under Alternatives C and D would allow vegetation used as food and cover for other wildlife to become more abundant, especially in zones that have deer densities far in excess of the desired level, such as zone 5. Therefore, the results of Alternatives C and D on other wildlife would be mostly beneficial and long-term, depending on the species. There could be long-term minor adverse effects to some species that prefer open habitat and short-term negligible adverse impacts from disturbance during the implementation of the action. Alternatives C and D are expected to result in long-term beneficial cumulative impacts on wildlife and wildlife habitats.

4.6 IMPACTS ON SPECIAL-STATUS SPECIES

4.6.1 GUIDING REGULATIONS AND POLICIES

The *Endangered Species Act* (16 USC. 1531 et seq.) and amendments (1973) mandate that all federal agencies consider the potential effects of their actions on species listed as threatened or endangered. If the NPS determines that an action may adversely affect a federally listed species, consultation with the U.S. Fish and Wildlife Service is required to ensure that the action will not jeopardize the species' continued existence or result in the destruction or adverse modification of critical habitat.

The NPS *Management Policies 2006* states that potential effects of agency actions will also be considered on state- or locally-listed species (NPS 2006a). The NPS is required to control access to important habitat for such species and to perpetuate the natural distribution and abundance of these species and the ecosystems upon which they depend. Although the NPS does not have a legal obligation to manage for state-listed species, it is required by the Organic Act to "conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations" (16 USC § 1). In addition, NPS *Management Policies 2006*, Section 4.4.2.2 states, "the National Park Service will…manage state and locally listed species in a manner similar to its treatment of federally listed species to the greatest extent possible" (NPS 2006a).

There is one federally listed animal species that occurs in Cuyahoga Valley National Park, the Indiana bat (endangered). The bald eagle was formerly listed but was delisted in 2007. It retains protection against take (including disturbance) at the federal level under the Bald and Golden Eagle Protection Act. These species are addressed in Chapter 1. These species were not carried through for additional analysis because adverse impacts to these species from any of the alternatives considered in this plan/EIS would be negligible to minor at most and short-term. No federally listed plant species are known to occur in Cuyahoga Valley National Park.

4.6.2 ASSUMPTIONS, METHODOLOGIES, AND INTENSITY DEFINITIONS

To assess impacts on listed species, the following process was used:

- Identification of which species are in areas likely to be affected by management actions described in the alternatives
- Analysis of habitat loss or alteration caused by the alternatives
- Analysis of disturbance potential of the actions and the species' potential to be affected by the actions.

The information in this analysis was obtained through best professional judgment of park staff and experts in the field (as cited in the text) and from relevant literature. The following thresholds were used to determine impacts to special-status species.

Negligible: Impacts on special-status species would result in no measurable or perceptible changes to a population or individuals of such species or its habitat. Impacts would be well within natural fluctuations.

Minor: Impacts on special-status species would result in measurable or perceptible changes to individuals of a species, a population, or its habitat, but would be localized within a relatively small area, and the overall viability of the species would not be affected. Mitigation measures, if needed to offset adverse impacts, would be simple and very likely successful.

Moderate: Impacts on special-status species would result in measurable and/or consequential changes to individuals of a species, a population, or its habitat; however, the impact would remain relatively localized. The viability of the species could be affected, but the species would not be permanently lost. Mitigation measures, if needed to offset adverse impacts, would be extensive but likely successful.

Major: Impacts on special-status species would result in measurable and/or consequential changes to a large number of individuals of a species or a population or a large area of its habitat. These changes would be substantial, highly noticeable, and permanent, potentially resulting in a loss of species viability and possible extirpation from the park. Extensive mitigation measures would be needed to offset any adverse impacts, and may not be successful.

4.6.3 AREA OF ANALYSIS

The area of analysis for assessment of impacts is Cuyahoga Valley National Park. The area of analysis for cumulative impacts is the park and the area within 1 mile of the park boundary, which encompasses typical deer movement outside the park boundary.

4.6.4 IMPACTS OF THE ALTERNATIVES

Alternative A: No Action (Continuation of Existing Management)

Analysis

Under Alternative A, park staff would continue to monitor the deer population and vegetation and would continue to use tree tubes or small-scale fencing to protect small areas of restored tree plantings.

Special-status Plant Species

Of the 39 state-listed plant species known to occur within the legislative boundary of the park, many are susceptible to deer damage because of their presence in habitat frequented by deer and/or their palatability to deer (see Appendix A) (NPS 2009b). The park currently does not selectively protect any populations of rare understory plant species that deer may browse, and this would not change under the no-action alternative. Therefore, impacts on those state-listed plant species that could be affected by deer or deer management would likely occur from the continued over browsing expected under Alternative A, as described in "Section 4.3, Impacts on Vegetation" for non-listed woody and herbaceous vegetation. These include tree and shrub species as arbor vitae (*Thuja occidentalis*) and great laurel (*Rhododendron maximum*), as well as many uncommon herbaceous plants such as various species of lady tresses (*Spiranthes* spp.) found in the park (see Appendix A). Browsing impacts to these species could result in a reduction of the species in the plant community, either because of mortality resulting directly from browsing or due to impacts to overall plant health, and its ability to produce seed stock or otherwise spread. Continuous browsing of preferred plants over time could result in the loss of individual species from the community. Similar impacts to sensitive species considered to be less palatable to deer but found in forest/upland habitat frequented by deer would also be expected if food resources were limited due to deer population growth, seasonal or climate variations (e.g., drought), or reductions in plant abundance resulting from disease or insect impacts. As a result, continued browsing pressure of an uncontrolled deer population would lead to long-term moderate to potentially major adverse impacts on several state-listed plant species not protected by fencing.

Conversely, there are several special-status plants that would not be affected to more than a negligible degree, because they are found in habitat not used by deer or are known to be unpalatable to deer. These are identified in Appendix A and include the following: American sweet-flag (*Acorus americanus*), Bebb's sedge (*Carex bebbii*), broad-winged sedge (*Carex alata*), deer's-tongue arrowhead (*Sagittaria rigida*), floating pondweed (*Potamogeton natans*), golden-fruited sedge (*Carex aurea*), golden-knees (*Chrysogonum virginianum*), greene's rush (*Juncus greenei*), ground juniper (*Juniperus communis*), leafy goldenrod (*Solidago squarrosa*), Olney's three-square (*Scirpus americanus*), rock harlequin (*Corydalis sempervirens*), seaside arrow-grass (*Triglochin maritimum*), and variegated scouring-rush (*Equisetum variegatum*).

Special-status Animal Species

The vegetation and habitat conditions described in Chapter 3, for vegetation and other wildlife and wildlife habitat indicates that deer have already affected vegetation, and thus habitat, for other wildlife species within the park, including those listed or considered special-status species by Ohio. The herbaceous and woody seedling layers of the forest have been browsed by deer, and monitoring results indicate a substantial decline in vegetation in paired unfenced plots compared to paired fenced plots, suggesting that the abundance and diversity of the animals using this understory habitat today could be affected.

As described in "Section 4.5, Impacts on Other Wildlife and Wildlife Habitat," the continued growth of the deer population and heavy deer browsing can degrade habitat and result in lack of food or cover for species that require ground vegetation to maintain viable populations within the park. This includes several species listed or considered special-status species by Ohio (see Table 3-10 in Chapter 3), such as ground-nesting or feeding birds (e.g., hermit thrush [*Catharus guttatus*], least flycatcher [*Empidonax minimus*], northern bobwhite [*Colinus virginianus*], and Henslow's sparrow [*Ammodramus henslowii*]). Other birds (e.g., brown creeper [*Certhia americana*], prothonotary warbler [*Prothonotaria citrea*], magnolia warbler [*Dendroica magnolia*]) that nest or forage in the understory shrub layer would also be affected if available food and cover would be greatly reduced by browsing. Habitat for the eastern box turtle (*Terrapene carolina*) mostly includes forests, and they feed on a wide variety of animal and plant life (Stickel 1989), using forested and open pasture terrestrial habitats and marshy meadow aquatic habitats. The absence of an understory or dense herbaceous layer that could be caused from continued deer over-browsing under Alternative A could cause a decrease in protective cover for the box turtle.

Many state-listed animal species would likely not be affected by deer or deer management actions to more than a negligible to minor degree, because they do not breed in the park, or do not breed or otherwise depend on habitat affected by deer browsing, or are not expected in areas that would be used for deer management actions such as placement of bait piles, sharpshooting, or trapping for reproductive control activities. This includes species that are mainly aquatic or associated with open water/emergent marsh habitats, or that are mainly upper canopy nesters, whose habitat would not be subject to heavy deer browsing and would not be close to most deer management activities. It also includes migrant species that do not breed or nest in the park; these species would be affected mainly by the noise or disturbance associated with deer management actions, and this would cause short-term negligible adverse impacts. In addition, grassland nesting birds such as Henslow's sparrow (*Ammodramus henslowii*) and bobolink (*Dolichonyx oryzivorus*) would benefit from deer browsing that keeps woody growth from taking over grassland habitat.

Those special-status animal species that would experience no or negligible adverse effects from the actions in this plan include the following (see Appendix A for additional information on preferred habitat): star-nosed mole (*Condylura cristata*), American bittern (*Botaurus lentiginosus*), black tern (*Chlidonias niger*), northern harrier (*Circus cyaneus*), yellow-bellied sapsucker (*Sphyrapicus varius*), upland sandpiper (*Bartramia longicauda*), peregrine falcon (*Falco peregrinus*), bald eagle (*Haliaeetus leucocephalus*), least bittern (*Ixobrychus exilis*), black-crowned night heron (*Nycticorax nycticorax*), osprey (*Pandion haliaetus*), great egret (*Ardea alba*), marsh wren (*Cistothorus palustris*), sedge wren (*Cistothorus platensis*), black vulture (*Coragyps atratus*), common moorhen (*Gallinula chloropus*), sora rail (*Porzana carolina*), Virginia rail (*Rallus limicola*), northern saw-whet owl (*Aegolius acadicus*), northern pintail (*Anas acuta*), American wigeon (*Anas americana*), northern shoveler (*Anas clypeata*), green-winged teal (*Anas crecca*), gadwall (*Anas strepera*), short-eared owl (*Asio flammeus*), long-eared owl (*Asio otus*), redhead duck (*Aythya americana*), black-throated blue warbler (*Dendroica caerulescens*), blackburnian warbler (*Dendroica fusca*), Wilson's snipe (*Gallinago delicata*), ruddy duck (*Oxyura jamaicensis*), northern waterthrush (*Seiurus noveboracensis*), pine siskin (*Carduelis pinus*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), cattle egret (*Bublucus ibis*), little blue heron (*Egretta caerulea*), queensnake (*Regina septemvittata*), spotted turtle (*Clemmys guttata*), and Blanding's turtle (*Emydoidea blandingii*).

Based on the above analysis, the impact of Alternative A on special-status species would be primarily adverse, long-term, and would range from negligible to potentially major, depending on the species and its dependence on habitat that is adversely impacted by deer browse. Species that depend on ground cover, young tree species, or understory shrubs for food, cover, or nesting habitat (such as ovenbird, veery, and eastern meadowlark) could be reduced or eliminated over time in at least some areas of the park, resulting in moderate to potentially major adverse effects. Impacts to wetland-dwelling herpetofauna

and species that depend on the middle to upper canopy, such as woodpeckers and owls, would be negligible.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions that could impact special-status species in and around the park include many of the same actions previously discussed under cumulative impacts to vegetation and other wildlife and wildlife habitat. Adverse impacts to special-status species have occurred and will continue to occur from increasing urban and suburban development, agricultural use, and transportation projects in the areas surrounding the park, which has resulted in removal of habitat in limited areas, disturbance, noise, habitat removal and fragmentation, and demise of preferred native plant species, causing short- and long-term minor to moderate localized adverse impacts. Visitor use off main trails has had long-term minor localized adverse impacts on plants due to trampling of vegetation, and/or spreading of noxious weed seeds, and will continue to do so in the future. Ongoing park maintenance and operations would have long-term minor adverse impacts on special-status species, mainly from temporary noise or disturbance, limited to the areas affected. The park's exotic plant management efforts and those of neighboring jurisdictions have had and will continue to have sizeable benefits to native vegetation, including special-status plant species, by controlling and limiting the spread of invasive and non-native species. Scientific research benefits park resources by supplying information needed for management decisions, and beneficial impacts have resulted from past and current deer management efforts undertaken by neighboring agencies and landowners, which have reduced deer numbers in and around the park and helped to limit browsing impacts on understory and herbaceous plants that are important habitat for many species.

The past, present, and reasonably foreseeable future actions described above would result in short- and long-term negligible to moderate adverse impacts as well as long-term beneficial impacts. These impacts, when combined with the negligible to potentially major impacts of continued pressure on woody and herbaceous vegetation that makes up the wildlife habitat and the limited natural regeneration expected under Alternative A because of continued deer browsing, would result in cumulative impacts that would be adverse, long-term, and minor to potentially major, depending on the species. Alternative A would contribute considerably to the overall adverse cumulative impact because of the expected continued deer browsing that would adversely affect native plants and wildlife food and cover.

Alternative B: Combined Nonlethal Actions

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative B. In addition, large-scale exclosures would be constructed and rotated for the purposes of forest regeneration. Non-surgical reproductive control would be used to reduce the deer population. Similar to other action alternatives, Alternative B would include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Special-status Plant Species

Impacts on state-listed species would be similar to those described for non-listed vegetation.

As described for Alternative A, deer browsing has already caused noticeable changes to vegetation. Browsing impacts on sensitive species could result in a reduction of species in the plant community and its ability to produce seed stock or otherwise spread. This species reduction would be caused by mortality

resulting directly from browsing or impacts on overall plant health. Continuous browsing of sensitive plants over time could result in the loss of individual species from the community, especially those that are palatable to deer and those located in preferred deer habitats. As a result, Alternative B would continue to have long-term moderate to major adverse impacts on the listed plant species that are susceptible to deer browse and those that are located primarily in deer habitat and are not protected by fencing.

Impacts from construction of the large scale exclosures and administration of reproductive control agents would result in ground disturbances, including trampling by workers, which could affect state-listed plant species and their habitat, but these impacts would be limited both because of the relatively small extent of the areas affected and the steps that would be taken to avoid injury to these plants. Exclosure areas would be surveyed for state-listed plants prior to construction and any plants identified would be avoided during fence installation. Personnel involved in these activities would be educated about the potential impacts of their actions on these plants. In addition, small areas of the park would be affected for only a short period, resulting in short-term negligible adverse impacts. If any of the state-listed plants were within an exclosure, there could be long-term beneficial effects by removing the impacts of deer over-browsing (i.e., trampling, browsing, seed dispersal, etc.) in these areas. However, because only 5 percent of the park would be fenced off from browsing deer at any one time, and because deer density outside protected areas would continue to remain high for many years, the beneficial impacts would be limited.

Special-status Animal Species

Impacts to state-listed animal species that could be affected by deer or deer management actions would be similar to those described in “Section 4.5, Impacts on Other Wildlife and Wildlife Habitat” for non-listed wildlife species. As with Alternative A, a continued high deer density and the associated browsing throughout the majority of the park would reduce the availability of food for wildlife listed or considered special-status species by Ohio that depend on ground/shrub layer vegetation for survival. This includes ground and/or shrub-nesting or foraging birds (e.g., brown creeper, prothonotary warbler, magnolia warbler), as well as the box turtle (see Table 3-10 in Chapter 3). Conversely, many species that do not breed or otherwise depend on habitat affected by deer browsing, or species that are not expected in areas that would be used for deer management actions, would be minimally affected. This includes species that are mainly aquatic or associated with open water/emergent marsh habitats, species that are mainly upper canopy nesters, and migrant species that do not breed or nest in the park. However, because of the potential of increased predation resulting from the lack of an understory due to continued over-browsing, the impacts on species that use the understory and ground layer (such as the eastern box turtle and ground nesting birds) would be long-term minor to major adverse, depending on the species and the extent of deer impacts.

Cumulative Impacts

The same past, current, and future actions described under Alternative A would occur under Alternative B., Long-term minor to moderate adverse impacts would result from development and other actions; beneficial impacts would result mainly from actions (such as control of invasive species and deer management by neighboring jurisdictions) that have helped reduce loss of habitat in the area of analysis. These impacts, when combined with the long-term negligible to potentially major adverse impacts of Alternative B, would result in long-term minor to potentially major adverse impacts, depending on the species. Alternative B would contribute considerably to the overall adverse cumulative impacts. This is because the exclosures and reproductive control actions taken would not be expected to result in a population reduction to the desired deer density goal in many areas of the park within the life of this management plan, and would not protect special-status plants and wildlife species enough to offset the adverse effects of the continued high deer density expected.

Alternative C: Lethal Actions (Sharpshooting and Capture/Euthanasia)

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative C. In addition, sharpshooting would be used under this alternative to reduce the deer population, along with capture and euthanasia in circumstances where sharpshooting would not be appropriate. Similar to other action alternatives, Alternative C would include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Special-status Plant Species

A reduced deer density throughout the majority of the park would promote the growth of sensitive species if suitable habitat characteristics and seed stock were present. A smaller deer herd density would reduce browsing pressure on native plant communities over time, resulting in reestablishment and an increase in the extent of natural communities in the park. Increased areas of native vegetation would be expected to promote the reestablishment of special-status plant species. Reducing deer herd density would decrease the potential for deer browsing impacts on sensitive species, resulting in long-term beneficial impacts. Some browsing of sensitive plant species (see Alternatives A and B) would be expected, even when herd density is maintained at target density levels. However, potential impacts on sensitive plant species would be reduced under this alternative, resulting in long-term beneficial impacts.

The implementation of sharpshooting and capture and euthanasia (where appropriate) would result in ground disturbance, including trampling by workers, that could affect state-listed plant species and their habitat. However, small areas of the park would be affected for only a short period and by relatively few individuals, resulting in short-term negligible adverse impacts.

Special-status Animal Species

Impacts to state-listed species would be similar to those described in “Section 4.5, Impacts on Other Wildlife and Wildlife Habitat” for non-listed wildlife species. As a result of a reduction in browsing pressure, the forests within the park would be expected to regenerate in areas where this is now lacking, and shrub and groundcover vegetation would propagate, providing cover and protection for species dependent on that habitat such as ground and shrub nesting birds (e.g., hermit thrush) and the box turtle, with long-term beneficial impacts. As noted previously, special-status animal species that depend primarily on other habitats such as wetlands and water bodies, tree canopies, and tree bark, or cavity nesters would be less affected by a reduced deer density, although a long-term benefit to upper canopy species could be gained in the future as forest regeneration maintained the upper canopy. Predatory wildlife listed or considered special-status species by Ohio (see Table 3-10 in Chapter 3), such as the sharp-shinned hawk, would find a denser understory more difficult for hunting small prey than the current open condition. However, these predators would benefit from better habitat conditions and an increase in the abundance of prey species. Other wildlife listed or considered special-status species that nest in grassland habitat, such as Henslow’s sparrow (*Ammodramus henslowii*), could experience negligible to minor adverse impacts. Many special-status species that do not depend on habitat affected by deer browsing, or those that are not expected in areas used for deer management actions, would experience no or negligible adverse impacts.

As described above, special-status wildlife could be temporarily disturbed by the presence of humans placing bait stations, shooting deer, setting traps, and observing deer behavior. However, because these actions would take place mainly during the non-breeding season for most animals, results would be short-

term and temporary, and the use of silencers would reduce noise impacts from shooting to a minimum. The small number of carcasses left for natural decomposition would not be substantially different than what occurs through mortality from disease, old age, and car collisions. Impacts from these actions would be negligible; they would not cause any measurable change to the habitat or responses by wildlife listed or considered special-status species by Ohio.

Cumulative Impacts

The same past, current, and future actions described under Alternative A would occur under Alternative C, with long-term minor to moderate adverse impacts from development and other actions and beneficial impacts mainly from control of invasive species and deer management by neighboring jurisdictions that have helped reduce loss of habitat in the area of analysis. These impacts, when combined with the long-term beneficial impacts and short-term negligible to long-term minor adverse impacts of Alternative C, would provide long-term beneficial impacts on special-status species. Alternative C would contribute considerably to the overall beneficial cumulative impacts. Under Alternative C, deer browsing pressure would be reduced through a rapid reduction of the deer population and this would allow a greater proportion of the forest to regenerate within a few years for herbaceous species to 10 years for woody species, improving habitat for many native plants and wildlife.

Alternative D: Combined Lethal and Nonlethal Actions

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative D. Lethal reduction would be implemented to reduce the deer population as described under Alternative C. Once the initial density goal is attained, reproductive control (as described in Alternative B) and lethal reduction (if needed) would be used to maintain the deer population at the reduced level. Similar to other all action alternatives, Alternative D would include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Special-status Plant Species

The implementation of Alternative D would result in ground disturbance, including trampling by people implementing the alternative, which could affect state-listed plant species and their habitat. However, small areas of the park would be affected for only a short period, and personnel involved in these activities would be educated about the potential impacts of their actions on these plants, resulting in short-term negligible adverse impacts. Alternative D would result in reduced deer density throughout the majority of the park. As described for Alternative C, this would promote the growth of sensitive plant species, reduce browsing pressure on native plant communities over time, and result in the reestablishment of special-status species. Reducing deer herd density would decrease the potential for deer browsing impacts on sensitive species, resulting in long-term beneficial impacts. Some browsing of sensitive plant species (see Alternatives A and B) occurring outside small, fenced exclosures would be expected, even when herd density is maintained within the desired deer density target level of 15 to 30 deer per square mile. However, potential impacts on sensitive plant species outside exclosures would be reduced, resulting in long-term beneficial impacts.

Special-status Animal Species

Impacts to state-listed animal species would be essentially the same as described for Alternative C. As a result of a reduction in browsing pressure, the forests within the park would be allowed to regenerate and

shrub and groundcover vegetation would propagate, providing cover and protection for species dependent on that habitat such as ground and shrub nesting birds (e.g., hermit thrush) and the box turtle, with long-term beneficial impacts. Special-status species that depend primarily on other habitats such as wetlands and water bodies, tree canopies, and tree bark, or cavity nesters, would be less affected by a reduced deer density, although a long-term benefit to upper canopy species could be gained in the future as forest regeneration maintained the upper canopy. Predatory wildlife listed or considered special-status species by Ohio (see Appendix A), such as the sharp-shinned hawk, would find a denser understory more difficult for hunting small prey than the current open condition. However, these predators would benefit from better habitat conditions and an increase in the abundance of prey species. Other wildlife listed or considered special-status species that nest in grassland, such as Henslow's sparrow (*Ammodramus henslowii*), could also be slightly adversely affected. Many special-status species that do not depend on habitat affected by deer browsing, or those that are not expected in areas used for deer management actions, would experience no or negligible adverse impacts.

As described above, special-status wildlife could be temporarily disturbed by the presence of humans placing bait stations, shooting deer, setting traps, and observing deer behavior. However, because these actions would take place mainly during the non-breeding season for most animals, results would be short-term and temporary, and the use of silencers would reduce noise impacts from shooting to a minimum. The small number of carcasses left for natural decomposition would not be substantially different than what occurs through mortality from disease, old age, and car collisions. Impacts from these actions would be negligible; they would not cause any measurable change to the habitat or responses by wildlife listed or considered special-status species by Ohio.

Cumulative Impacts

The same past, current, and future actions described under Alternative A would occur under Alternative D, with long-term minor to moderate adverse impacts from development and other actions and beneficial impacts mainly from control of invasive species and deer management by neighboring jurisdictions that have helped reduce loss of habitat in the area of analysis. These impacts, when combined with the long-term beneficial impacts and short-term negligible to long-term minor adverse impacts of Alternative D, would provide long-term beneficial impacts on special-status species. Alternative D would contribute considerably to the overall beneficial cumulative impacts. Under Alternative D, deer browsing pressure would be reduced through a rapid reduction of the deer population and this would allow a greater proportion of the forest to regenerate within a few years for herbaceous species to 10 years for woody species, improving habitat for many native plants and wildlife.

4.6.5 CONCLUSION

Under Alternatives A and B, special-status species would experience primarily adverse, long-term, and negligible to potentially major impacts, depending on the species. Species that depend on ground cover and young tree seedlings or understory shrubs for food or cover or native plants could be severely reduced or eliminated from the park, whereas impacts on species that depend primarily on other habitats (not woodlands) or on the upper canopy for food and cover would be negligible. Alternatives A and B are expected to result in adverse, long-term, and minor to potentially major cumulative impacts, depending on the species. Overall, the long-term reduction and controls on deer population growth under Alternatives C and D would allow vegetation used as food and cover for sensitive wildlife to become more abundant, especially in zones that have deer densities far in excess of the desired level, such as zone 5, and would decrease browse on sensitive plants. Therefore, Alternatives C and D would result in mostly beneficial and long-term impacts to special-status species, depending on the species. There could be long-term minor adverse effects to some species that prefer open habitat and short-term negligible adverse impacts

from disturbance during the implementation of the action. Alternatives C and D are expected to result in long-term beneficial cumulative impacts on special-status species.

4.7 IMPACTS ON RURAL LANDSCAPES

4.7.1 GUIDING REGULATIONS AND POLICIES

As previously noted, rural landscapes are a type of cultural landscape, which is one type of cultural resource. Federal actions that have the potential to affect cultural resources are subject to a variety of laws. The National Historic Preservation Act (NHPA) (1966, as amended) is the principal legislative authority for managing cultural resources associated with NPS projects. Generally, Section 106 of the act requires all federal agencies to consider the effects of their actions on cultural resources listed on or determined eligible for listing in the National Register of Historic Places (NRHP). Agreement on how to mitigate effects to these resources is reached through consultation with the State Historic Preservation Officer (SHPO); the Tribal Historic Preservation Officer, if applicable; and the Advisory Council on Historic Preservation (ACHP), as necessary. In addition, federal agencies must minimize potential impacts to these resources that would be adversely affected by a federal undertaking. Other important laws or executive orders designed to protect cultural landscapes include Executive Order 11593, "Protection and Enhancement of the Cultural Environment."

Through legislation the NPS is charged with the protection and management of cultural resources in its custody. This is furthered implemented through Director's Order 28: *Cultural Resource Management* (NPS 2002h), as well as NPS-28: Cultural Resource Management Guideline (NPS 1998); NPS *Management Policies 2006* (NPS 2006a); and the "Programmatic Agreement among the National Park Service, (U.S. Department of the Interior), the ACHP, and the National Conference of State Historic Preservation Officers for Compliance with Section 106 of the National Historic Preservation Act" (ACHP 2008). These documents charge NPS managers with avoiding or minimizing to the greatest degree practicable, adverse impacts on park resources and values. Although the NPS has the discretion to allow certain impacts in parks, that discretion is limited by the statutory requirement that park resources and values remain unimpaired, unless a specific law directly provides otherwise.

The park completed a Rural Landscape Management Program/Environmental Impact Statement in September 2003 (NPS 2003). This program provides for the long-term management of the rural landscape in the park, which is covered under the Countryside Initiative Program (preferred alternative in the EIS), as described in the "Affected Environment" chapter of this document. Under the Countryside Initiative, the rural landscape is managed largely by issuing long-term leases to private individuals for sustainable agricultural use, and Countryside Initiative farmers must submit annual operating plans to the NPS for approval. Because Countryside Initiative farmers need to protect their products from foraging wildlife, fencing is expected to be used, but must be in conformance with NPS fencing guidelines.

4.7.2 ASSUMPTIONS, METHODOLOGIES, AND INTENSITY DEFINITIONS

The NPS categorizes cultural resources as archeological resources, cultural landscapes, historic structures, museum objects, and ethnographic resources. As noted in "Section 1.8, Issues and Impact Topics" in Chapter 1, only impacts to rural landscapes, a type of cultural landscape, have been retained for detailed analysis in this plan/EIS. The term "rural landscape" used in this section includes themes involving agriculture (Countryside Initiative farms) and recreation related to use of the Virginia Kendall State Park Historic District in the park. The descriptions of effects on rural landscapes that are presented in this section are intended to comply with the requirements of both NEPA and Section 106 of the NHPA for all cultural resources. In accordance with the regulations of the ACHP on implementing Section 106 (36

CFR Part 800, Protection of Historic Properties), impacts on cultural resources are to be identified and evaluated by (1) determining the area of potential effects; (2) identifying cultural resources present in the area of potential effects that are either listed on or eligible to be listed in the NRHP; (3) applying the criteria of an adverse effect to affected cultural resources either listed on or eligible to be listed in the NRHP; and (4) considering ways to avoid, minimize, or mitigate adverse effects.

Under ACHP regulations, a determination of either *adverse effect* or *no adverse effect* must also be made for affected cultural resources eligible for listing in the NRHP. An *adverse effect* occurs whenever an impact alters, directly or indirectly, any of the characteristics that qualify the resource for inclusion in the NRHP (for example, diminishing the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association). Adverse effects also include reasonably foreseeable effects caused by the proposal that would occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5, Assessment of Adverse Effects). A determination of *no adverse effect* means there would either be no effect or that the effect would not diminish in any way the characteristics that qualify the cultural resource for inclusion in the NRHP.

CEQ regulations and the NPS Director's Order 12 also call for a discussion of the appropriateness of mitigation, as well as an analysis of how effective the mitigation would be in reducing the intensity of a potential impact (e.g., reducing the intensity of an impact from major to moderate or minor). Any resultant reduction in the intensity of an impact due to mitigation, however, is an estimate of the effectiveness of mitigation under NEPA only. Cultural resources are nonrenewable resources, and adverse effects generally consume, diminish, or destroy the original historic materials or form, resulting in a loss in the integrity of the resource that can never be recovered. Therefore, although actions determined to have an adverse effect under Section 106 of the NHPA may be mitigated, the effect remains adverse.

A Section 106 summary is included in the impact analysis sections for rural landscapes. The Section 106 summary is an assessment of the effect of the undertaking (implementation of the alternative) only on any rural landscapes that are listed on or eligible for the NRHP, based on the criteria of effect and criteria of adverse effect found in the regulations of the ACHP.

For purposes of analyzing potential impacts on rural landscapes, the definitions of change for the intensity of an impact are defined as follows:

Negligible: The impact would be at the lowest level of detection, with neither adverse nor beneficial consequences.

Minor: Alteration of a pattern(s) or feature(s) of the rural landscape listed on or eligible for listing on the NRHP would not diminish the overall integrity of the rural landscape.

Moderate: The impact would alter a pattern(s) or feature(s) of the rural landscape, diminishing the overall integrity of the landscape, although adverse impacts could be mitigated to reduce any major effects to at least moderate adverse levels.

Major: The impact would alter a pattern(s) or feature(s) of the rural landscape, diminishing the overall integrity of the resource, and adverse impacts could not be mitigated

4.7.3 AREA OF ANALYSIS

For the purpose of this analysis, the area of potential effect for all impacts, including cumulative impacts, is defined as the entirety of Cuyahoga Valley National Park.

4.7.4 IMPACTS OF THE ALTERNATIVES

Alternative A: No Action (Continuation of Existing Management)

Analysis

Under Alternative A, park staff would continue to monitor the deer population and vegetation and continue to use tree tubes or small-scale fencing to protect small areas of restored tree plantings. Deer populations would be expected to remain at high levels and browsing would continue throughout the park, causing a decline in the long-term abundance and diversity of native plant species and contributing to further establishment of invasive exotic species within the park. As a result, the character-defining feature of the contrasting patterns of farmsteads, hardwood forests, open meadows, row crops, and pastures of the rural landscape would continue to deteriorate. The degree of impact would depend on the size of the future deer population, the location of the rural landscapes in relation to areas of high deer density, the degree of continued decline in forest regeneration, and the susceptibility of the particular plantings to deer browse. Continued heavy deer browsing on crops could prevent this rural landscape from being productive and could alter the open and closed patterns of the rural landscape, resulting in minor to moderate adverse effects on rural landscapes. If the existing situation continues, the success of agricultural ventures could be reduced or hampered, resulting in a long-term, moderate, adverse impact on the rural landscape.

Maintaining small fenced areas and protecting restoration plantings (e.g., protective tree tubes) would protect select species from deer browsing. However, these actions would have little effect on the overall rural landscape, since these protected areas are not located on the identified rural landscape properties within the park. Therefore, the impact of maintaining current monitoring and fencing activities would be long-term and beneficial, but at a very minimal scale, and would not reduce parkwide adverse impacts.

Cumulative Impacts

Several past, current, and reasonably foreseeable future actions would contribute to the cumulative impact on the rural landscape at the park, including transportation, residential and commercial development outside the park, deer management practices within park boundary and in surrounding areas by other entities, and the continued implementation of the Countryside Initiative Program.

Land development in areas adjacent to the park affect views and vistas, gradually eroding the sense of place that used to surround the park. Character-defining features of a rural landscape include changes, either individually or collectively, that have occurred over time. Particularly affected are vulnerable sites on the immediate boundary of the park. Land development in these areas contributes to the reduction of rural landscapes in the general vicinity and can reduce continuity of the rural landscapes that transcend park boundaries. Much of the adjacent property has been and continues to be developed into residential and commercial uses, often removing farmland from production and changing the land use patterns in the vicinity of the park, causing minor adverse impacts to park rural landscapes.

Deer management practices in and around the park by private farmers and by local Metroparks organizations have helped keep the deer population in check in many areas, which in turn benefits the park's rural landscapes by preventing overbrowsing and crop damage. Both Cleveland Metroparks and MPSSC have managed and continue to manage the deer herd through sharpshooting on lands they own within and adjacent to the park's authorized boundary. Actions of the local metro parks organizations are expected to continue annually for the remainder of the life of this plan. The Countryside Initiative has a goal of more than 1,300 acres of agricultural production over a period of 10–15 years. Currently, there are 53 active fields, totaling 234 acres, in the Countryside Initiative program within the park. The permanent

fencing used to protect fields in the Countryside Initiative from deer browsing would have a long-term minor to moderate adverse impact on the visual character of the rural landscape, and temporary fencing would have a short-term minor to possibly moderate adverse effect. However, the increase expected in the creation of farmlands over the life of this plan would have a substantial long-term beneficial impact on rural landscapes.

The past, present, and reasonably foreseeable futures actions described above, especially the proactive steps taken by the Countryside Initiative and deer management actions of neighboring jurisdictions, would result in mainly beneficial effects on rural landscapes, with some minor to moderate adverse effects from land development and fencing. These impacts, when combined with the moderate adverse impacts under Alternative A from the continued decline of forests and crops, would result in long-term, minor to moderate adverse cumulative impacts to the rural landscape. Alternative A would contribute considerably to the overall adverse cumulative impact because of the lack of reduction in the deer herd and the continued decline of forests and crops in rural landscapes due to deer browsing.

Alternative B: Combined Nonlethal Action

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative B. In addition, large-scale exclosures would be constructed and rotated for the purposes of forest regeneration. Non-surgical reproductive control would be used to reduce the deer population. Similar to other action alternatives, Alternative B would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Park staff would construct up to 30 large exclosures, each approximately 1,000 feet × 1,000 feet, and each covering 23 acres, scattered throughout the park Since their express purpose is aid in forest regeneration, these exclosures would not surround active agricultural areas. Thus, these actions would have little direct effect on existing farm viability, and would provide only limited benefits on the rural landscape by restoring woody vegetation on certain areas. However, restricting deer from the exclosed areas within the park could encourage deer to browse on active farmlands or other areas that do not have protective fencing. Also, the woven-wire, 8-foot fenced exclosures would introduce new structural elements into the park's overall landscape that would be inconsistent with the park's contributing buildings and farmsteads. To mitigate these potential impacts to the rural landscape, the exclosures would be located some distance from common visitor use areas as much as possible so that they would not intrude on these landscapes. However, the exclosures might be visible during the winter and spring from locations within the park where the views are contributing features to rural landscapes that are located throughout the entire park. Due to their materials and construction, they would be difficult to see. Regardless, the presence and visibility of these exclosures may result in long-term minor to moderate adverse impacts to particular rural landscapes due to increase browsing pressure on non-protected farms or forested areas and their detraction from the scenic value of the rural landscape, depending on their location.

Alternative B would also include the implementation of non-surgical reproductive control if an appropriate control agent is available. This would involve the use of bait piles and possibly temporary holding pens. Bait piles would be placed in unobtrusive locations so as not to impact the visitor's appreciation of the rural landscape. The same is true of temporary holding areas or pens; these would be placed in locations away from rural landscape features, limiting adverse impacts to negligible levels. Reproductive control techniques for does would gradually limit deer population growth over the longer term and allow for regeneration of native plant communities outside the exclosures, with long-term beneficial minor impacts to the park's rural landscapes, but, as described in "Section 4.3, Impacts on

Vegetation," this benefit may not occur within the life of this plan. Deer numbers would be expected to remain at high levels over the life of the plan; browsing would continue throughout the park, especially in zones with the highest deer density, and cause a decline in the long-term abundance and diversity of native plant species, particularly to susceptible landscape plantings and crops that are integral to many of the park's rural landscapes. As a result, there would be long-term adverse minor to moderate impacts to the park's rural landscapes (depending on the landscape and the plants importance to the landscape) over the life of the plan. The degree of impact would depend on the size of the future deer population and the associated degree of impact on the park plant communities and the susceptibility of the particular planting to deer browse.

Cumulative Impacts

The same past, current, and future actions described under Alternative A would also occur under Alternative B, with primarily beneficial impacts due to deer management actions of park neighbors and the continuation of the Countryside Initiative, and some minor to moderate adverse effects due to land development and fencing. These impacts, when combined with the long-term minor to moderate adverse impacts of Alternative B, would result in long-term moderate adverse cumulative impacts to rural landscapes. Alternative B would contribute considerably to the overall adverse cumulative impact because of the lack of reduction in the deer herd and the associated browsing impacts on rural landscape components, and also the visual impacts of exclosures.

Alternative C: Lethal Action (Sharpshooting and Capture/Euthanasia)

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative C. In addition, sharpshooting would be used under this alternative to reduce the deer population, along with capture and euthanasia in circumstances where sharpshooting would not be appropriate. Similar to other action alternatives, Alternative C would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Reducing the deer population size to about 21 deer per square mile and maintaining the population at an appropriate density over time as determined by adaptive management would result in diminished browsing pressure. Decreased browsing and thus decreased deer depredations of agricultural crops would lead to increased chances of viability for the park's farm ventures and maintain the open and closed patterns of the rural landscape. This would result in beneficial, long-term impacts on the park's rural landscapes. Since sharpshooting activities related to deer reduction, including setting up bait stations, occupying shooting areas, and dragging deer to locations for processing, transport, or burial likely would not take place within the 85 properties that contribute to the contemporary rural landscape (NPS 2003), these specific activities would result in short-term, negligible adverse impacts on the rural landscape related mainly to the temporary noise and presence of crews in nearby areas of the park.

Cumulative Impacts

The same past, current, and future impacts described under Alternative A would also occur under Alternative C, with primarily beneficial impacts due to deer management actions of park neighbors and the continuation of the Countryside Initiative, and some minor to moderate adverse effects due to land development and fencing. These impacts when combined with the short-term negligible adverse and long-term, beneficial impacts of Alternative C, would result in a long-term, beneficial cumulative impact on

the rural landscape. Alternative C would contribute considerably to the overall beneficial cumulative impact because of the reduction in deer browse damage to landscape and crops.

Alternative D: Combined Lethal and Nonlethal Actions

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative D. Lethal reduction would be implemented to reduce the deer population as described under Alternative C. Once the initial density goal were attained, reproductive control (as described in Alternative B) and lethal reduction (if needed) would be used to maintain the deer population at the reduced level. Similar to other all action alternatives, Alternative D would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Impacts under this alternative would be essentially the same as Alternative C. Decreased browsing and thus decreased deer depredations of agricultural crops would lead to increased chances of viability for the park's farm venture and maintain the open and closed patterns of the rural landscape. Some short-term, negligible adverse impacts could also result from the implementation of the sharpshooting activities themselves, as described under Alternative C.

Cumulative Impacts

The same past, current, and future impacts described under Alternative A would also occur under Alternative D, with primarily beneficial impacts due to deer management actions of park neighbors and the continuation of the Countryside Initiative, and some minor to moderate adverse effects due to land development and fencing. These impacts, when combined with the short-term negligible adverse and long-term, beneficial impacts of Alternative D, would result in a long-term, beneficial cumulative impact on the rural landscape. Alternative D would contribute considerably to the overall beneficial cumulative impact because of the reduction in deer browse damage to landscape and crops.

4.7.5 CONCLUSION

Under Alternative A, the rural landscape would experience long-term, moderate, adverse impacts due to the continued high levels of the deer population and the associated ongoing depredation of plantings and crops by deer in unfenced rural landscape areas. Under Alternative B, the rural landscape would experience long-term, moderate adverse impacts because in the majority of the park, agricultural crops and other vegetation would continue to be adversely affected by deer browsing until reproductive controls became effective and the population decreased. The presence of exclosures would result in long-term minor to moderate adverse impacts to the cultural landscapes in which they are located. Alternatives C and D would result in short-term negligible adverse but mostly long-term beneficial impacts due to decreased browsing and thus decreased deer depredations of agricultural crops. This would lead to increased chances of viability for the park's farm ventures and maintain the open and closed patterns of the rural landscape. Alternative A would result in long-term, minor to moderate, adverse cumulative impacts to the park's rural landscape. Under Alternative B, long-term moderate adverse impacts would result. Alternatives A and B would contribute considerably to the overall adverse cumulative impact because of the lack of reduction in the deer herd and the continued decline of forests and crops in rural landscapes due to deer browsing. Alternatives C and D would result in long-term, beneficial cumulative impacts on the rural landscape. Alternatives C and D would contribute considerable benefits to the overall cumulative impact because of the reduced pressure on crops and other vegetation.

4.7.6 NATIONAL HISTORIC PRESERVATION ACT SECTION 106 SUMMARY

This plan/EIS analyzes the impacts of four alternatives on rural landscapes in Cuyahoga Valley National Park. The alternatives include a no-action alternative and three action alternatives.

Under Alternative A, continued growth in the existing deer population and excessive deer browsing would continue to limit successful regeneration of native plant communities within the park and result in crop damage, resulting in an adverse, long-term, moderate impact to the park's rural landscape. Potential beneficial impacts to the park's rural landscapes could result from the use of small fenced areas to protect small groups of native plants and, if threatened by deer browsing, to protect landscape plantings, reducing the need for replanting trees. Because there would be a continued decline of native plant communities and little natural tree regeneration due to continued deer browsing and continued adverse impacts on crops, implementation of Alternative A would result in an *adverse effect* on the park's rural landscape.

Under Alternative B, 30 large exclosures, each approximately 1,000 feet × 1,000 feet, and each covering 23 acres would be constructed, scattered throughout the park. Since their express purpose is aid in forest regeneration, these exclosures would not surround active agricultural areas. The fences would be a new structural element within the landscape. They would be temporary and would be placed in areas not easily visible to visitors if possible, but could result in minor to moderate adverse impacts on the character of the rural landscape due to their visual presence and the potential for even more intense browsing outside the fenced areas. Reproductive control measures would also be implemented under Alternative B, but would take many years to be effective, so there would be long-term moderate adverse impacts for the life of this plan, since the deer population would not be reduced enough to reduce impacts on crops and other plantings and native vegetation that contributes to rural landscapes. Therefore, Alternative B would result in an *adverse effect* on the park's cultural landscape.

Under Alternative C, the quick reduction of the deer population would cause a substantial decline in browsing of native plant populations and crops. Native plants would begin to regenerate, resulting in long-term benefits to native plants, a character-defining vegetation feature in the park's rural landscape. Therefore, *no adverse effect* would result from actions taken under Alternative C.

Alternative D would be a combination of reproductive controls described in Alternative B and lethal controls described in Alternative C. These combined actions would result in a direct reduction in the deer population and the protection of vegetation including crop that is an identifying characteristic of the rural landscape, resulting in a *no adverse effect* under Alternative D.

In accordance with Section 106 of the NHPA, potential adverse impacts (as defined in 36 CFR 800) on rural landscapes listed on or eligible for listing in the NRHP would be coordinated between the NPS and the SHPO to determine the level of effect on the property and to determine any necessary mitigation measures. Continuing implementation of the *Cultural Resource Management Guideline* (NPS 2002i) and adherence to NPS *Management Policies 2006* (NPS 2006a) and the 1995 Servicewide programmatic agreement with the ACHP and National Conference of SHPOs would all aid in reducing the potential to adversely impact these resources.

Copies of this plan/EIS will be distributed to the Ohio SHPO for review and comment related to compliance with Section 106 of the NHPA.

4.8 IMPACTS ON SOCIOECONOMICS/ADJACENT LANDS

4.8.1 GUIDING REGULATIONS AND POLICIES

NEPA requires that economic and social impacts be analyzed in an EIS when they are interrelated with natural or physical impacts. Economic impacts would potentially result from deer browsing damage to crops and landscaping on private lands adjacent to the park as a result of changes in the deer population in Cuyahoga Valley National Park. The extent of such impacts would be in large part dependent on the size of the deer population, outside development pressures, and loss of deer habitat.

4.8.2 ASSUMPTIONS, METHODOLOGIES, AND INTENSITY DEFINITIONS

Because of the limited supply of deer forage within the park, deer may also browse on crops and landscape plantings on adjacent lands outside the park boundaries. It is assumed that deer that are habituated to the park may seek food sources outside the park if browse is not available within the park. Recent studies indicate that the sex and age of the deer and quality of habitat will result in home ranges of varying sizes. Yearling males will move many miles, whereas adult females usually have smaller, more consistent annual home ranges. Deer in high quality habitat will travel less than deer in poorer quality habitat (Maryland Department of Natural Resources n.d.). The Iowa Department of Natural Resources reports that white-tailed deer home range may expand seasonally based on breeding activity and food availability (Iowa Department of Natural Resources 2005).

Damage to landscaping on private land is a common problem in certain parts of the United States, resulting in economic losses in the form of decreased property values or the costs of protecting or replacing susceptible vegetation. Crop loss associated with deer damage to agricultural lands has a direct economic effect to the farmer. Impact intensity definitions for socioeconomic conditions therefore focus on landscaping or crop damage on neighboring lands and were defined as follows:

Negligible: No effects would occur, or the effects on neighboring landowners or other socioeconomic conditions would be below or at the level of detection.

Minor: The effects on neighboring landowners or other socioeconomic conditions would be small but detectable. The impact would be slight, but would not be detectable outside the neighboring lands and would affect only a few adjacent landowners.

Moderate: The effects on neighboring landowners or other socioeconomic conditions would be readily apparent. Changes in economic or social conditions would be limited and confined locally, and they would affect more than a few landowners.

Major: The effects on neighboring landowners or other socioeconomic conditions would be readily apparent. Changes in social or economic conditions would be substantial, extend beyond the local area, and affect the majority of landowners.

4.8.3 AREA OF ANALYSIS

The area of analysis for both direct and cumulative impacts includes the park and adjacent lands within 1 mile of the park's boundary, based on the typical home range for deer.

4.8.4 IMPACTS OF THE ALTERNATIVES

Alternative A: No Action (Continuation of Existing Management)

Analysis

Under Alternative A, park staff would continue monitoring the deer population and vegetation and continue to use tree tubes or small-scale fencing to protect small areas of restored tree plantings. Since no action would be taken to reduce deer numbers, it is expected that deer populations would remain at high levels (exceeding 30 deer per square mile) in many areas of the park, although numbers would fluctuate annually due to winter temperatures snow depths and duration of snow cover, food availability, and reproduction and mortality rates due to herd health, among other factors. Deer would continue to use their existing home range, which is estimated to extend about a mile beyond the park's boundary, and may travel further based on food availability. Private landowners within or adjacent to the park could experience increased deer browsing on plants in landscaped areas over the short- and long-term as food sources decreased or remained limited within the park due to population pressures. Ornamental plantings grown on private lands adjacent to the park could be browsed more heavily, resulting in adverse economic impacts to landowners. The degree of physical and economic damage on adjacent lands would depend on growth in deer populations, types of plantings, market value of current plantings, and actions landowners use to manage deer. Damage to landscaping may result in a decline in property values for affected landowners, resulting in short- and possibly long-term minor to moderate adverse impacts. Property owners could also undertake measures to replace damaged landscaping or pursue protection mechanisms, which would also have an associated cost. Landowners would most likely incur additional costs for fencing, repellents, and other forms of deer control to protect their landscaping as the deer population continues at high levels under this alternative. The time and monetary costs associated with acquiring additional protection measures would result in adverse, long-term, minor impacts to private landowners, depending on the number of landowners that used such measures.

A high deer population would also have adverse effects on adjacent agricultural land owners. As noted in Chapter 3, a survey of wildlife damage to agricultural lands within the park determined that deer were one of the primary causes of agricultural losses, particularly for sweet and field corn, orchards, and pumpkins (Labovitz 1994). A growing deer population would most likely have a nonlinear effect on crop damage, meaning that crop damage costs could increase proportionately more than increases in the deer population (McNew and Curtis 1997). Therefore, a short-term increase in the deer population could escalate costs associated with crop damage assuming that deer use private lands within their home range. Farmers would most likely incur additional costs for fencing, repellents, and other forms of deer control to protect their crops as the deer population grows under this alternative. Increased deer browsing could result in additional monetary and time costs associated with harvesting deer on their lands through control mechanisms. McNew and Curtis (1997) found that the higher the loss due to deer damage, the more likely that a farmer would request a deer damage permit. Monetary and time costs associated with acquiring additional protection measures would result in long-term, minor adverse impacts to private landowners, depending on the number of landowners that used such measures. These costs could result in short- and long-term, minor to moderate adverse impacts to farmers in and around the park depending on the extent of crop damage and costs associated with property protection measures.

Cumulative Impacts

Several past, present, and reasonably foreseeable future actions would contribute to cumulative impacts on socioeconomics/adjacent lands in and within close proximity to the park.

Urban, suburban, and commercial development would continue throughout the life of this plan. Roadway and rail improvements in the area may also induce additional development other than what is currently planned. Development activities in and outside the park have and would continue to reduce and fragment natural habitat. As such lands are replaced by landscaped habitat, deer may browse these areas for food, particularly when other food sources are scarce within their home range. This would result in short- and long-term, minor to moderate adverse impacts to adjacent landowners, the extent of which would depend on the amount of deer damage.

Cleveland Metroparks and MPSSC, both located in Summit County, have and continue to manage the deer population through sharpshooting on lands they own in and adjacent to the park's authorized boundary. The density of the park's deer herd is a contributing factor in the density of the herd on adjacent lands. Any reduction in the presence of deer on private lands would reduce the economic impact of deer damage. As a result, such actions would continue to be long-term and beneficial.

The park's past and future land acquisitions would continue to have impacts on socioeconomics/adjacent lands. Previous land acquisition has prevented certain parcels from being developed for residential and commercial purposes or converted to agricultural land. Lands maintained as parkland under the auspices of the park would help preserve deer browse areas. The conversion of these lands for residential and/or agricultural use would decrease the amount of deer browse areas available, yet may not prevent deer from frequenting these areas unless property owners install fences. An increase in residential landscaping and agricultural crops may result in additional deer damage borne by private property owners. Therefore, the acquisition of land by the park would result in long-term, beneficial impacts.

The past, present, and reasonably foreseeable future actions described above would result in long-term minor to moderate adverse impacts and long-term beneficial impacts. These impacts, when combined with the short- and long-term minor to moderate adverse impacts of Alternative A, would result in long-term, minor to moderate adverse cumulative impacts on socioeconomics/adjacent lands in and around the park. Alternative A would contribute considerably to the overall adverse cumulative impact because of the landscape and crop damage due to deer overbrowsing that would be expected to continue with no reduction in deer density.

Alternative B: Combined Nonlethal Actions

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative B. In addition, large-scale exclosures would be constructed and rotated for the purposes of forest regeneration. Non-surgical reproductive control would be used to reduce the deer population. Similar to other action alternatives, Alternative B would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Reproductive control, if successful, this would gradually reduce the deer population over the long term; however, deer numbers would not be immediately reduced and numbers would fluctuate annually. The forage range of the deer could expand due to reduced forage availability due to exclosures, resulting in greater deer browsing outside the park where food may be more plentiful, similar to Alternative A. Also, the number of deer that would seek food sources outside the park could be larger under this alternative because the large-scale rotational exclosures would restrict deer from browsing on about 690 acres (30 exclosures at about 23 acres each) within the park and encourage deer browsing on adjacent private lands, including active farmlands.

The availability and effectiveness of reproductive controls in the future could reduce the intensity of property and crop damage impacts because the deer population would decrease gradually, minimizing landscaping and crop damage and reducing the need for protection mechanisms. However, it is not expected that there would be a substantial decrease in deer density under Alternative B during the life of this plan, especially in zones with the highest deer density like zone 5. Although it is possible to meet the reduced population goal over time, the risk of not meeting that goal is high under this alternative. In the meantime, landowners adjacent to the park would continue to incur additional costs for fencing, repellents, and other forms of deer control to protect their landscaping and crops. Because deer would be displaced from the park due to the rotational fencing, these costs would most likely be greater than in Alternative A, and residents may suffer losses in vegetation and incur costs for replacement of lost vegetation or deterrents such as fencing. Because population reduction would likely not be realized in the life of the plan, this would result in a long-term, moderate, adverse impact.

Cumulative Impacts

The same past, present, and reasonably foreseeable future actions described under Alternative A would also occur under Alternative B, with long-term minor to moderate adverse impacts and long-term beneficial effects. These impacts, when combined with the short- and long-term minor but mostly moderate adverse impacts of Alternative B, would result in long-term, moderate, adverse cumulative impacts on socioeconomics/adjacent lands in and within close proximity to the park. Alternative B would contribute considerably to the overall adverse cumulative impact because of the lack of substantial reduction in the deer density over the life of this plan, which would result in little reduction in landscape and crop damage.

Alternative C: Lethal Actions (Sharpshooting and Capture/Euthanasia)

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative C. In addition, sharpshooting would be used under this alternative to reduce the deer population, along with capture and euthanasia in circumstances where sharpshooting would not be appropriate. Similar to other action alternatives, Alternative C would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Actions taken under Alternative C would quickly reduce the deer population density to within the desired range of approximately 15 to 30 deer per square mile (22 deer per square mile attained in year 4), and additional deer would be removed in subsequent years to maintain the population. Initial sharpshooting activities may push additional deer from one area of the park to another, or out of the park. However, the reduction of the existing park deer population may result in fewer deer leaving the park and browsing on landscaping on adjacent lands, depending on where the sharpshooting was focused and the home range locations of the deer. During the reduction activities, deer movements could become erratic and unpredictable. This could result in temporarily expanded home ranges. However, once the lethal reduction activities were reduced, observations at similar locations indicate that the deer would return to their original home range. The removal of nearly 50 percent of the existing deer herd in Cuyahoga Valley National Park in the long term would likely result in far fewer deer leaving the park to search for food because the habitat in the park could better support the reduced population. Acreage within the park would most likely provide sufficient browse for a reduced deer population. A corresponding decline in costs for fencing, repellents, and other forms of deer control to protect landscaping and crops could also occur as the park deer population was reduced. As a result, reduced time and monetary costs associated with protection measures would reduce adverse, long-term impacts to private landowners to minor

because they might still incur protection costs, but the cost would likely decrease noticeably. The reduction in the damage to neighboring landscaping and crops and the reduced cost for protection measures would result in long-term beneficial impacts to socioeconomics/adjacent lands, assuming that park deer populations are currently foraging on private lands adjacent to the park.

Cumulative Impacts

The same past, present, and reasonably foreseeable future actions described under Alternative A would also occur under Alternative C, with long-term minor to moderate adverse impacts and long-term beneficial impacts. These impacts, when combined with the long-term beneficial impacts of Alternative C, would result in long-term, beneficial cumulative impacts on socioeconomics/adjacent lands in and within close proximity to the park. Alternative C would contribute considerably to the overall beneficial cumulative impact because of the relatively rapid reduction in the deer density and the associated reduction in landscaping or crop damage or need for protection.

Alternative D: Combined Lethal and Nonlethal Actions

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative D. Lethal reduction would be implemented to reduce the deer population as described under Alternative C. Once the initial density goals were attained, reproductive control (as described in Alternative B) and lethal reduction (if needed) would be used to maintain the deer population at the reduced level. Similar to other action alternatives, Alternative D would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Under Alternative D, once the goal of 15 to 30 deer per square mile was obtained in year 4, reproductive control, as described in Alternative B, and lethal reduction (if needed) would be used to maintain the deer population at the reduced level. However, the success of implementing reproductive controls on a deer population that has undergone several years of lethal reduction efforts would depend on technological advances, the sensitivity of deer to humans, methods used by the sharpshooters, changes in immigration with reduced deer density, and general deer movement behavior (Porter, Underwood, and Woodward 2004; Naugle et al. 2002). If reproductive controls were found to be unsuccessful, deer numbers could be kept low via lethal reduction. A decreased population would provide additional protection to local properties. Deer browsing impacts would continue at some level, but adverse impacts to landowners would be reduced to negligible or minor levels over the short- and long-term, and landscaping and crop damage would be reduced, and fencing, repellents, and other forms of deer control to protect landscaping would also decline, resulting in long-term beneficial impacts.

The overall impact of Alternative D on socioeconomics/adjacent lands would be long-term and beneficial.

Cumulative Impacts

Cumulative impacts would be similar to those described for Alternative C. The same past, present, and reasonably foreseeable future actions described under Alternative A would also occur under Alternative D, with long-term minor to moderate adverse impacts and long-term beneficial impacts. These impacts, when combined with the long-term beneficial impacts of Alternative D, would result in long-term, beneficial cumulative impacts on socioeconomics/adjacent lands in and within close proximity to the park. Alternative D would contribute considerably to the overall beneficial cumulative impact because of

the relatively rapid reduction in the deer density and the associated reduction in landscaping or crop damage or need for protection.

4.8.5 CONCLUSION

Under Alternative A, socioeconomics/adjacent lands would experience direct and long-term, minor to moderate, adverse impacts because of the continued high density of deer expected over the life of this plan and the associated costs of landscape damage, crop loss, and additional costs for fencing, repellents, and other forms of deer control to protect landscaping. Alternative B would have mostly long-term moderate adverse impacts (direct and cumulative) for the same reasons, but with the additional impact of precluding deer from the large exclosures, which could add to browsing pressure on surrounding lands. Alternatives A and B would contribute considerably to the overall adverse cumulative impacts.

Under Alternatives C and D, socioeconomics/adjacent lands would experience direct, long-term beneficial impacts. The relatively rapid reduction in deer density would reduce adverse impacts to landowners, due to improved crop yields and preserved landscaping and reduce the need for landscape and crop protection. Alternatives C and D would contribute considerably to the overall beneficial cumulative impacts.

4.9 IMPACTS ON VISITOR USE AND EXPERIENCE

4.9.1 GUIDING REGULATIONS AND POLICIES

The NPS *Management Policies 2006* (NPS 2006a) state that the enjoyment of park resources and values by the people of the United States is part of the fundamental purpose of all parks and that the NPS is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks. Management goals include making available to the public traditional outdoor recreational opportunities that are not detrimental to the natural or cultural resources of the park.

While preservation and conservation are key components of the NPS *Management Policies*, they also instruct park units to provide for recreational opportunities. The NPS achieves its preservation and conservation purposes by working to maintain all native plants and animals as parts of the natural ecosystem, emphasizing preservation and conservation over recreation. The NPS will achieve this by preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur (NPS 2006a). According to the Cuyahoga Valley National Park's General Management Plan (NPS 1977), "the visitor use/interpretation concept for the park stresses recreational activities and programs designed to complement and focus on the resources base and to stimulate appreciation of the total Cuyahoga environment." The park's general management plan also includes the following management policy that pertains to visitor use and experience:

- Management for visitor use of the park will focus on recreational settings and programs rather than facility development. The NPS will seek to provide for as wide a variety of recreational, interpretive, and educational uses as possible, as long as these uses reflect resource constraints and are compatible with the valley landscapes.

4.9.2 ASSUMPTIONS, METHODOLOGIES, AND INTENSITY DEFINITIONS

Past visitor use data and personal observations of visitation patterns were used to estimate the effects of the alternative actions on visitors. The impact on the ability of visitors to experience a full range of park resources was analyzed. The definitions for the intensity of an impact are defined as follows:

Negligible: Visitors would not be affected or changes in visitor use and/or experience would be below or at the level of detection. The visitor likely would not be aware of the impacts associated with the alternative.

Minor: Changes in visitor use and/or experience would be detectable, although the changes would be slight. The visitor would be aware of the impacts associated with the alternative, but the impacts would be slight.

Moderate: Changes in visitor use and/or experience would be readily apparent. The visitor would be aware of the impacts associated with the alternative and would likely express an opinion about the changes.

Major: Changes in visitor use and/or experience would be readily apparent and severely adverse. The visitor would be aware of the impacts associated with the alternative and would likely express a strong opinion about the changes.

4.9.3 AREA OF ANALYSIS

The area of analysis, including the cumulative impacts analysis, is Cuyahoga Valley National Park.

4.9.4 IMPACTS OF THE ALTERNATIVES

Alternative A: No Action (Continuation of Existing Management)

Analysis

Under Alternative A, park staff would continue to monitor the deer population and vegetation and continue to use tree tubes or small-scale fencing to protect small areas of restored tree plantings.

Walking, running, biking, and hiking on the Ohio & Erie Canal Towpath Trail are very popular visitor activities. Based on the 2005 visitor study conducted by the NPS, hiking/walking, bicycling, and scenic driving are the most popular activities in the park (Lee, Littlejohn, and Hollenhorst 2006). This study indicated that 18 percent of the survey participants listed “nature viewing/bird watching” as an activity conducted in the park and 2 percent listed nature viewing/bird watching as the primary reason for visiting the park. Wildlife species that are most often viewed by visitors are white-tailed deer; great blue herons, bald eagles and other birds; and beaver and coyote. Wildlife-viewing visitors also include amateur and professional birdwatchers.

As the deer population continues to remain high and the overbrowsing of native plants continues, the diversity and abundance of many species would be expected to diminish or remain low, especially in zones with the highest deer densities such as zone 5. A distinctive browse line would be evident in areas with excessive numbers of deer, and, in addition, overbrowsing by deer gives invasive exotic plant species an opportunity to become established, which may deter native species propagation. Visitors who value native scenery or viewing the parks’ rural landscape would be most affected, and adverse impacts to visitor experience from heavily browsed vegetation would be long-term, localized, and range from minor

to moderate. Those visitors that value nature viewing would also be affected by the impacts of deer browse on wildlife including deer themselves.

Under this alternative, it is expected that the deer population would grow and/or remain at high levels, adversely impacting native plants and, as a result, wildlife and wildlife habitat through overbrowsing. Overbrowsing could adversely impact habitat that supports the park's bird species, particularly birds that use the ground or low shrub layer for nesting and feeding. Therefore, the park visitors who value native plants and wildlife, including the many birdwatchers that use the park, could experience long-term, adverse, minor to moderate impacts as the diversity and abundance of native vegetation and wildlife habitat in the park remains low or decreases as a result of deer browsing. Although it is not known what percent of visitors place a high importance specifically on seeing deer, any visitors who do so would have a higher chance of viewing deer under this alternative than under other alternatives, a long-term benefit. However, an increase in deer numbers could also adversely affect the condition of the herd, and if the deer population drastically declined due to disease or malnutrition, visitor experience could be adversely affected until the herd recovered. This would result in a long-term, minor to moderate, adverse impact.

Tree tubes and small fenced areas used to protect plants could occur in view of the hiking/walking trails, bike trails, and/or roadways, These measures would indirectly adversely affect visitor experience to the park that are utilizing these recreational resources as a result of their visibility, a negligible to minor adverse impact. However, they also serve to protect rare plants and vegetation that visitors would not otherwise see due to excessive deer browsing. Visitors who primarily experience the park by scenic driving would be the least affected, as fenced areas would be difficult to detect while driving. Visitors who primarily experience the park by hiking or walking would be affected to a greater degree, depending on the location of the trail and the number of fences encountered.

Educational efforts included under this alternative, such as communication with the public about deer management activities as described in "Chapter 2: Alternatives," would help offset adverse impacts on all park visitors, who would be informed of the reasons for implementing the management activities. Monitoring efforts described under this alternative, such as deer population surveys and vegetation monitoring, would have little to no impact on visitors since surveys would be conducted at night when visitation is low, and most visitors would likely interpret vegetation monitoring as consistent with scientific efforts expected at a unit of the national park system.

Given the differences in desired visitor experience, impacts to visitor use and experience under Alternative A would be both beneficial and adverse to those visitors who maybe primarily interested in viewing deer (beneficial in that there would be more deer to see, adverse in that the appearance of the herd could be poor if the herd experiences density-dependent health issues). However, overall impacts related to a decreased ability to view scenery (including native vegetation and the rural landscape) and other wildlife, which is important to many visitors using the park, would be long-term, minor to moderate, adverse.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions that could impact visitor use and experience include those actions that impact the forest and visual character of the park that are enjoyed by park visitors. Increased impacts on the forest are expected from increased development around the park and within the park, including a park trail management plan, construction of fences associated with the Countryside Initiative, and highway development around the park. Because most visitors, according to the 2005 visitor survey, rated hiking/walking and bicycling as the most common activities in the park, impacts resulting from activities such as construction of fences and development around the park would result in adverse impacts which would be long-term and negligible, as these impacts would not occur in

areas where visitors would be hiking/walking or bicycling. The future park trail management plan and the construction of hiking and biking trails would result in long-term beneficial impacts as the majority of visitors surveyed utilize the park for hiking, bicycling, and walking. It is expected that the new trails within the park would likely connect to communities outside the park, making visitor access to the park easier and more enjoyable.

The past, present, and reasonably foreseeable future actions described above would result in mostly long-term beneficial impacts. These impacts, when combined with the long-term negligible to moderate adverse impacts and long-term beneficial impacts of Alternative A, would result in long-term negligible adverse cumulative impacts on visitor use and experience. Alternative A would contribute considerably to the overall adverse cumulative impacts because of the effects of continued overbrowsing on the forest resources and rural landscape components of the park that are used and valued by many visitors for a variety of reasons.

Alternative B: Combined Nonlethal Actions

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative B. In addition, large-scale exclosures would be constructed and rotated for the purposes of forest regeneration. Non-surgical reproductive control would be used to reduce the deer population. Similar to other action alternatives, Alternative B would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Tree tubes and small fenced areas described under Alternative A would continue to be used under Alternative B, but large fenced exclosures would be constructed to allow reforestation. Park staff would construct up to 23 large exclosures of various configurations to fit the landscape, each covering from about 30 acres or up to a total of approximately 690 acres. This represents approximately 5 percent of the entire park. The exclosures would be located in various zones, with emphasis on those areas needing protection from browsing, with relatively easy access yet located away from high use visitor areas or scenic views as much as possible. The use of such large exclosures would adversely impact visitors that use the areas in or near the locations selected in that these fenced areas would be obvious and closed to visitation. Visitors would also be affected by fence construction activities, which would result in temporary visual and noise intrusions, such as the presence of work crews and employees in certain areas of the forest. Visitors hiking in the park to view wildlife and scenery in low-use visitor areas would be most affected. This group would include backpackers, cross-country skiers, and nature photographers who may desire a more natural, primitive park experience. Visitors to may also be adversely affected by intrusions on the rural landscape. Those who primarily experience the park by car might not be as affected by the sight of the exclosures, which would probably not be detectable from vehicles. The park plans to implement deer management educational and interpretive efforts under all alternatives, and visitors would be made aware of the reasons for the exclosures and their benefit to forest regeneration, which would beneficially impact visitors with the knowledge that the natural environment would eventually improve. Such information could offset adverse impacts related to visual aesthetics caused by the exclosures. Adverse impacts within the life of this plan would be negligible to minor and short-term, and benefits would be realized in the longer term as the forest regenerates due to protection afforded by the exclosures.

The use of reproductive controls on does would be based on available technology. Approximately 90 percent of the does (approximately 722 does) would need to be treated every other year (see Chapter 2), mostly during the winter months. Unless it was found that the selected reproductive control agent had an extended efficacy exceeding two years, treatment would occur at approximately this level over the life of

the plan. Deer would be treated with reproductive controls using traps to capture them prior to administering the injections by hand and marking them. These activities would be limited to primarily to the months between October and March. Although treatment areas, including bait piles, would be done during less busy visitation periods and avoid highly used visitor areas to the extent possible, it is possible that some visitors would be exposed to treatment activities or that visitor access would be restricted around areas where bait piles were placed to attract deer for treatment. To ensure that visitors would understand the nature of the treatment efforts, the park would conduct educational programs to inform visitors about the procedures and explain why the treatments are necessary. However, visitors may see various aspects of the reproductive control operations, which could result in minor adverse impacts to their visitor experience.

With reproductive control, deer would be marked with ear tags or some equivalent marking in order to avoid multiple treatments of the same does in the same year or to facilitate tracking for future application in subsequent years. Visitors could be troubled by the sight of deer with artificial markings, particularly those who primarily come to the park to see deer. Again, educational material would alert visitors to deer management activities and explain their purpose and expected outcomes.

As reproductive controls eventually take effect and the deer population begins to decrease over time, some park visitors might notice reductions in the excessive browsing pressure that has been damaging forest resources. There would be an increased ability to view certain plants and animals that have been affected by deer overbrowsing, such as ground nesting birds and herbaceous species like trillium. However, as described in “Section 4.3, Impacts on Vegetation,” many years would be required to achieve these beneficial impacts. Overall, short-term impacts would be adverse and minor to moderate, with gradual long-term benefits, likely occurring beyond the life of this plan.

Those visitors who are interested primarily in seeing deer could be adversely affected over the longer term. However, the herd size would not be reduced much within the life of this plan, and so adverse impacts would be negligible. Also, even after reproductive control is successful, deer would not be rare, but they would be more in balance with other elements of the ecosystem as reproductive control limited herd size. Eventually the herd might be healthier under this alternative as compared to Alternative A. Therefore, visitors who value seeing deer might also prefer seeing fewer deer if it means maintaining a healthy, viable herd, which could lessen the intensity of the adverse impact to these visitors to negligible or minor.

Given the differences in desired visitor experience, impacts to visitor use and experience under Alternative B would be both beneficial and adverse to those visitors desiring to see deer, similar to Alternative A, since deer would still be present in relatively high numbers for a long time. Overall adverse impacts to visitor use and experience would be negligible to minor, and impacts would gradually become beneficial in the long term, beyond the life of this plan.

Cumulative Impacts

The same past, present, and future actions described under Alternative A would also occur under Alternative B, with mostly long-term beneficial impacts. These impacts, when combined with the long-term negligible to mostly minor adverse impacts and the gradual beneficial impacts of Alternative B, would result in mostly long-term beneficial cumulative impacts on visitor use and experience. Alternative B would add a small benefit to the cumulative impacts due to the effects of combined forest regeneration activities, which would enhance the overall visitor experience.

Alternative C: Lethal Actions (Sharpshooting and Capture/Euthanasia)

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative C. In addition, sharpshooting would be used under this alternative to reduce the deer population, along with capture and euthanasia in circumstances where sharpshooting would not be appropriate. Similar to other action alternatives, Alternative C would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Visitors would be affected primarily by closures required to conduct the direct reduction activities. However, sharpshooting activities would occur when visitation is low (during winter months), and primarily at night and outside developed areas. The public would be notified of any park closures in advance, information regarding deer management would be displayed at visitor contact facilities, and information would be posted on the park's website to inform the public of deer management actions. Visitor access could be limited as necessary while reductions were taking place, and NPS personnel would patrol public areas to ensure compliance with park closures and public safety measures. Silencers would be used to decrease impacts to the soundscape, and visitors would only be affected by noise if sharpshooting occurred during the day and in areas that were not restricted or closed to visitor use. Because sharpshooting activities would occur at times of low park usage (during fall and winter months, and primarily at night), adverse impacts to visitors related to closures or noise from high-power, small caliber rifles with silencers would be negligible. Impacts would be both short- and long-term, as limited sharpshooting activities would continue beyond the initial four-year reduction period to maintain the target population in the future.

In certain circumstances, deer being captured and euthanized could adversely affect visitors. If necessary, deer would be captured as humanely as possible using methods such as nets or box traps, which visitors might see if hiking near trapping locations. However, capture and euthanasia would occur at dawn or dusk when visitation is low. Because this method would be used only in limited circumstances, the likelihood of visitors being exposed to deer being captured and euthanized would be low. Impacts on visitor use would be sporadic over the life of this plan, adverse, and negligible.

It is the park's intention to donate as much of the meat as possible to local charitable organizations. If this is done, there would be little waste to be buried or disposed of at an appropriate processing facility. Surface disposal might be acceptable in limited situations where access to the carcass was difficult or not in a highly visible area. In these circumstances, every effort would be made to reduce the visibility of carcasses to visitors or park neighbors, limiting adverse impacts to negligible levels.

The park plans to implement deer management educational and interpretive efforts under all alternatives, and visitors would be made aware of the reasons for the direct reduction activities and their benefit to forest regeneration.

Long-term beneficial impacts would occur to most visitors because the forest would regenerate relatively quickly, creating increased ability to view a healthier understory and herbaceous plant such as spring wildflowers, and providing improved habitat for a variety of species. Forest regeneration would help ensure that visitors would be able to experience the park as an example of the natural regeneration of disturbed lands, and to experience nature's ability to regenerate. Beneficial impacts and forest regeneration would be realized relatively rapidly in areas most affected by deer browse, as direct reduction would have an immediate impact on the size of the deer herd. Regeneration would begin to occur after the desired deer density was achieved (after 4 years) and the forest would be expected to meet

regeneration goals approximately 10 years after the desired deer density is met. Maintaining a viable herd size would help ensure a more balanced ecosystem into the future.

With the reduction in deer, the ability to see deer would decrease, and those visitors who are interested primarily in seeing deer would be adversely affected. However, the herd size would not be reduced to the extent that deer would become rare in the park, rather they would still be visible, but they would be more in balance with other elements of the ecosystem. The herd might be healthier under this alternative as compared to Alternative A. Therefore, visitors who value seeing deer might also prefer seeing fewer deer if it means maintaining a healthy, viable herd, which could lessen the intensity of the adverse impact to these visitors to negligible or minor. Park visitors who value bird-watching or general wildlife viewing could experience beneficial impacts under this alternative as the increase in wildlife that had been affected by overbrowsing would occur as a result of the regenerated forest.

There are others who are opposed to lethal management of deer in the park and who may experience short-term, moderate to even major adverse impacts from the implementation of this alternative. A study that analyzed the beliefs and attitudes towards lethal reduction of deer at the park (Fulton et al. 2004) indicates that a minority of residents (15–20 percent) surrounding the park can be expected to continue to find lethal control very unacceptable as a management strategy for addressing abundant the deer populations at the park, despite the reasons it would be implemented. Additionally, a lethal management program for deer in the park is likely to have negative emotional impacts on a majority of those who feel lethal deer control is unacceptable and discourage a minority of those (approximately 30–40 percent) from visiting the park or participating in staff-led activities. If a lethal deer management alternative is implemented, educational and interpretive information would be provided to the public that addresses these issues in a respectful and honest fashion, but it is recognized that some visitors would have a negative reaction to this alternative

Given the differences in desired visitor experience, impacts on the visitor use and experience under Alternative C would be varied, with some visitors experiencing up to moderate to major short- and long-term adverse impacts on their experience, but with long-term beneficial impacts to many other visitors who value viewing a variety of wildlife, plants, and the rural landscape as the forest recovers.

Cumulative Impacts

The same past, present, and future actions described under Alternative A would also occur under Alternative C, with mostly long-term benefits. These impacts, when combined with the short-term, minor to possibly major adverse impacts on visitor use and experience, as well as the long-term beneficial impacts of the recovered forest, are expected to result in long-term negligible adverse impacts. Long-term beneficial impacts would occur as a result of forest regeneration due to the restoration of natural resources.

Alternative D: Combined Lethal and Nonlethal Actions

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative D. Lethal reduction would be implemented to reduce the deer population as described under Alternative C. Once the initial density goal is attained, reproductive control (as described in Alternative B) and lethal reduction (if needed) would be used to maintain the deer population at the reduced level. Similar to other all action alternatives, Alternative D would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Adverse impacts related to sharpshooting activities would be long-term and negligible, since they would primarily occur during fall and winter and at night, but beneficial impacts would result from a relatively rapid reduction in deer herd size, which would result in enhanced forest regeneration. Disposal of deer carcasses and waste would occur as described under Alternative C. Visitors would only be slightly affected by the continued use of small fenced areas and repellents, a negligible impact. Reproductive control would be applied after sharpshooting efforts had reduced the deer population. Therefore, reproductive control activities would augment direct reduction to reduce deer browsing pressure and allow forest regeneration, increasing the quality of the park's scenery and the diversity of its plants and animals. Resulting impacts to visitors would be beneficial and long-term. Adverse impacts could occur from visitors being exposed to reproductive control activities and associated area closures, and up to major adverse impacts could occur to that subset of visitors who are opposed to lethal removals. Educational and interpretive activities would help explain why deer management is needed.

As under the other action alternatives, visitors interested primarily in seeing deer could be adversely affected by the long-term reduction in the deer population. However, adverse impacts to these visitors would be negligible for the reasons mentioned under Alternatives B and C. Similar to Alternative C, impacts on the visitor use and experience under Alternative D would vary, with some visitors experiencing moderate to major short-term adverse impacts to their experience, but with long-term beneficial impacts to many other visitors as the forest recovers.

Cumulative Impacts

The same past, present, and future actions described under Alternative A would also occur under Alternative D, with mostly long-term beneficial impacts. These impacts, when combined with the short-term, minor to possibly major adverse impacts on visitor use and experience, as well as the long-term beneficial impacts of the recovered forest, are expected to result in long-term negligible adverse impacts. Long-term beneficial impacts would occur as a result of forest regeneration due to the restoration of natural resources.

4.9.5 CONCLUSION

It is recognized that an overall conclusion for this topic is difficult, since impacts on visitor use and experience under all alternatives will vary depending on the desired use and perceptions of the visitors, many of whom have strong opinions about deer and deer management. Under Alternative A, visitors who maybe primarily interested in viewing deer would experience beneficial and adverse impacts (beneficial because there would be more deer to see, adverse because the appearance of the herd could be poor). However, there would be long-term minor to moderate adverse overall impacts related to a decreased ability to view scenery (including native vegetation and the rural landscape) and other wildlife, which is important to many visitors using the park. Under Alternative B visitors would experience beneficial and adverse impacts, similar to Alternative A, since deer would still be present in relatively high numbers for a long time. Adverse impacts to visitor use and experience from the presence of exclosures and the continued effects of deer overbrowsing would range from negligible to moderate, and impacts related to forest regeneration would gradually become beneficial in the long term, beyond the life of this plan. Visitors may see various aspects of the reproductive control operations, which could result in minor adverse impacts to their visitor experience. Alternative A would result in long-term negligible adverse cumulative impacts and Alternative B would result in long-term beneficial impacts.

Impacts on the visitor use and experience under Alternatives C and D would be similar and would vary between users. Impacts would be short- and long-term, minor to major adverse to those opposed to lethal deer management within the park and from disturbance during implementation of the action, but long-term and beneficial to those who value an increase in vegetative and wildlife diversity and being able to

view natural and rural landscapes unaffected by overbrowsing. Alternative C or D would result in long-term negligible adverse cumulative impacts, which recognizes the balance between the benefits and the major adverse effects on some portion of the visitor population.

4.10 IMPACTS ON VISITOR AND EMPLOYEE HEALTH AND SAFETY

4.10.1 GUIDING REGULATIONS AND POLICIES

The NPS *Management Policies 2006* state that, "while recognizing that there are limitations on its capability to totally eliminate all hazards, the Service …will seek to provide a safe and healthful environment for visitors and employees." The policies also state that "the Service will reduce or remove known hazards and apply other appropriate measures, including closures, guarding, signing, or other forms of education" (NPS 2006a, sec. 8.2.5.1).

4.10.2 ASSUMPTIONS, METHODOLOGIES, AND INTENSITY DEFINITIONS

The health and safety of both the visitors and NPS employees at the park could be affected by implementation of the proposed deer management actions. Impacts on visitor and employee safety would be related to the probability of being involved in a deer-vehicle collision or encountering a deer tick resulting in contracting Lyme disease under all alternatives, the use of firearms under Alternatives C or D, and the potential for any accidents that could result from implementation of the other proposed actions.

The purpose of this impact analysis is to identify the level of impact that implementing each of the proposed alternatives would have on the health and safety of visitors and employees at the park. Past accident data were used to assess the impacts of the alternative actions on the health and safety of visitors and employees. The impact definitions for visitor and employee health and safety are defined below.

Negligible: There would be no discernible effects to visitor or employee safety; slight injuries could occur, but none would be reportable.

Minor: Any reported visitor or employee injury would require first aid that could be provided by park staff; for employees, the injury would involve less than eight hours of lost work time.

Moderate: Any reported visitor or employee injury would require further medical attention beyond what was available at the park; for employees, the injury would result in eight or more hours of lost work time.

Major: A visitor or employee injury would result in permanent disability or death.

4.10.3 AREA OF ANALYSIS

The area of analysis, including cumulative impacts, is Cuyahoga Valley National Park.

4.10.4 IMPACTS OF THE ALTERNATIVES

Alternative A: No Action (Continuation of Existing Management)

Analysis

Under Alternative A, park staff would continue to monitor the deer population and vegetation and continue to use tree tubes or small-scale fencing to protect small areas of restored tree plantings.

Implementation of Deer Management Actions

Park staff would continue to erect small fenced around sensitive plants and apply repellents to landscaped areas under Alternative A. They would also continue monitoring activities and deer population surveys. No accidents or injuries have occurred as a result of these activities, and no accidents are anticipated from their continuation. These activities would result in long-term, negligible, adverse impacts on visitor and employee safety.

Deer-Vehicle Collisions

Under Alternative A, the high deer population would continue to contribute to vehicle accidents experienced by visitors and staff using park roads, resulting in up to possibly major adverse effects on visitors and employees if the accident were severe, resulting in permanent disability or death. Visitation at the park is expected to result in continued pressure for various recreational uses, and the potential for accidents and vehicle collisions would remain. Chapter 3 notes that deer-vehicle collisions in the communities in and around the park in Cuyahoga and Summit Counties decreased from 273 in 2001 to 187 in 2005 (ODPS 2006). Culling efforts around Cuyahoga Valley National Park in Cuyahoga and Summit counties could account for part of the decline. Although a decline within each county as a whole has been noted, deer-vehicle collisions in both Cuyahoga and Summit are high when compared to other counties of Ohio: in 2007, Cuyahoga ranked 19th and Summit ranked 3rd out of 88 counties (ODPS 2008).

Therefore, although there have not been any reported injuries related to deer- vehicle collisions, the likelihood of being involved in a deer-vehicle collision would remain high, which could result in long-term minor to potentially major adverse impacts to visitor and employee safety.

Lyme Disease

A high deer population provides more host animals and may support higher than normal deer tick populations compared to environments with a lower deer density. Deer ticks are responsible for transmission of the spirochete that causes Lyme disease to humans. With no reduction in the deer population, there would be no anticipated changes in tick populations within the park. Although the number of visitors and employees that have encountered a deer tick or acquired Lyme disease within the park is unknown, the chance for such impacts would continue. Therefore, long-term adverse impacts related to the potential for contracting Lyme disease are expected to be negligible to moderate.

Cumulative Impacts

The past, present, and reasonably foreseeable future actions that could impact health and safety include typical tripping, falling, and slipping accidents sustained by both visitors and employees, since there is inherent danger in any park, with generally negligible to moderate adverse effects. Hunting that occurs outside the park would also affect health and safety in several ways. Hunting would reduce the number of

deer in the area and would likely result in fewer deer inside the park, which would decrease the likelihood of deer-vehicle collisions. Hunting outside the park could also decrease the prevalence of deer ticks and possible reduce the transmission of Lyme disease, and reduce necessary management actions by employees inside the park. This would result in long-term beneficial impacts to visitor and employee health and safety. However, hunting near the park boundary could result in injuries to visitors or employees nearby. There was one incident recorded in 2008, which involved a hunter's arrow being shot into the park boundary. No one was hit or injured as a result of this incident, but it indicates that the potential exists. Therefore, impacts from hunting outside the park could have long-term, negligible (no injuries) to moderate (more serious injury) adverse impacts on visitor and employee health and safety, as well as long-term benefits.

The beneficial and negligible to moderate adverse impacts and potential impacts of the above actions, when combined with the long-term negligible to potentially major adverse impacts of Alternative A, would result in long-term moderate adverse cumulative impacts on health and safety. Alternative A would contribute considerably to the overall adverse cumulative impacts because of the higher potential for deer-vehicle collisions and possibly Lyme disease transmission with no reduction in the deer population.

Alternative B: Combined Nonlethal Actions

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative B. In addition, large-scale exclosures would be constructed and rotated for the purposes of forest regeneration. Non-surgical reproductive control would be used to reduce the deer population. Similar to other action alternatives, Alternative B would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Implementation of Deer Management Actions

Although the level of employee involvement in deer management activities under this alternative would increase compared to Alternative A, impacts would remain relatively low due to the safety precautions that would be taken and the use of properly trained employees or authorized agents. Large exclosures would be constructed throughout the park and would be relocated as vegetation regrowth exceeded deer browsing height (60 inches or 150 centimeters). Based on discussions of the science team, it is estimated it would take about 10 years for regrowth to reach this height. Employees could be injured while constructing the exclosures; however, park staff typically exercise caution and apply safety techniques in all construction projects, as defined by the park's training and awareness activities. Visitors would not be able to use the fenced areas during or after construction. Park staff would place exclosures in locations so as to minimize impacts on visitor use wherever possible, offsetting any related safety issues. No impacts on visitor safety from increased monitoring are expected, as such activities would apply primarily to monitoring exclosures, which would be closed to visitors, and open forested areas, where park staff would exercise safety precautions.

Under this alternative, qualified federal employees or authorized agents would treat does with a reproductive agent. Approximately 90 percent of the does in the park (a minimum of 772 does assuming 50 percent of the deer in the park are does) would need to be treated annually from October through March. Although potential injuries (kicks, bites, stabbing with antlers) could occur during deer handling, they are expected to be minimal since the capture and treatment of deer would be conducted by qualified federal employees or authorized agents who are professionally trained to perform these tasks. Every precaution would be taken to ensure the safety of employees, and employees would apply safety training

and awareness activities designed to reduce safety risks. In addition, qualified federal employees or authorized agents would be trained in handling live deer in order to prevent disease transmission and prevent harm to employees. This would result in a short-term, negligible to minor, adverse impact.

Deer-Vehicle Collisions

With no significant reduction in the deer population expected over the life of the plan, there would be no anticipated reductions in the existing number of deer-vehicle collisions. In fact, by preventing the deer population from accessing areas enclosed by the rotational fencing, more deer may be encouraged to move to other parts of the park or surrounding areas, thus increasing the possibility of deer-vehicle collisions. This would result in a long-term, minor to potentially major, adverse impact, similar to Alternative A

Lyme Disease

With no significant reduction in the deer population over the life of the plan, there would be no anticipated reductions in tick populations within the park. In fact, by preventing the deer population from accessing areas enclosed by the rotational fencing, more deer may be encouraged to move to other parts of the park or surrounding areas, thus increasing the possibility encountering a deer tick or Lyme disease. Although the number of visitors and employees who have encountered a deer tick or acquired Lyme disease within the park is unknown, the likelihood of encountering a deer tick would remain high (CDC 2009; Stafford 2007). This would result in a long-term, negligible to moderate, adverse impact.

Cumulative Impacts

The same past, present, and reasonably foreseeable future actions described under Alternative A would also occur under Alternative B, with beneficial and negligible to moderate adverse impacts and potential impacts on the health and safety of NPS staff and visitors. These impacts, when combined with the long-term negligible to potentially major adverse impacts of Alternative B, would result in long-term moderate adverse cumulative impacts on health and safety. Alternative B would contribute considerably to the overall adverse cumulative impacts because of the higher potential for deer- vehicle collisions and Lyme disease transmission with the expected very gradual reduction in the deer population.

Alternative C: Lethal Actions (Sharpshooting and Capture/Euthanasia)

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative C. In addition, sharpshooting would be used under this alternative to reduce the deer population, along with capture and euthanasia in circumstances where sharpshooting would not be appropriate. Similar to other action alternatives, Alternative C would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Implementation of Deer Management Actions

The safety of park employees could be affected by sharpshooting and capture and euthanasia activities proposed under this alternative. Qualified federal employees or authorized agents would conduct the sharpshooting activities, and their experience in such efforts would help ensure the safety of visitors and park employees. Deer would be shot with high-power, small caliber rifles at close range. Measures taken to ensure the safety of park visitors would include shooting at night during late fall or winter months

when visitation is low, closing areas to visitors if shooting is required, notifying the public in advance of any park closures, providing information regarding deer management actions in the visitor contact facilities, and posting information on the park's website. Law enforcement personnel would also patrol the perimeter areas where sharpshooting would occur, and a safe distance would be maintained from any occupied building. Bait stations would be used to attract deer to safe removal locations. Park staff would approve the location of bait stations before sharpshooting took place. Activities would be in compliance with all federal firearm laws administered by the ATF. The majority of deer reduction activities would occur during the first four years of this plan, decreasing in scope (and the potential for accidents) during ensuing years as the deer population declined.

Qualified federal employees or authorized agents would also capture and euthanize deer; as such actions would occur in limited situations when sharpshooting was not appropriate. Therefore, impacts on the safety of employees could increase from potential injuries (kicks, bites, stabbing with antlers) that could occur during deer handling. Every precaution would be taken to ensure the safety of employees, and employees would apply safety training and awareness activities designed to reduce safety risks. Although more risks would be involved under this alternative due to the use of firearms, adverse impacts on the safety of employees would be expected to be negligible to minor due to the safety precautions park staff would follow.

Capturing and euthanizing deer could also affect the safety of visitors and adjacent property owners. It is unlikely that visitors would be exposed to such action, which would occur primarily at dawn or dusk. If this method were required to remove multiple deer, the area would be temporarily closed to visitors.

Deer-Vehicle Collisions

Although the direct relationship is unknown, research suggests that a decrease in the local deer population could reduce the number of deer-vehicle collisions (Curtis et al. 2002). Another recent paper by DeNicola and Williams (2008) concluded that reducing suburban deer populations through sharpshooting reduces deer-vehicle collisions. They report that in three suburban communities, sharpshooting management projects reduced deer herds by 54%, 72%, and 76%, with resulting reductions in deer-vehicle collisions of 49%, 75%, and 78%, respectively. These communities were described as typical suburban developments with a matrix of suburban and commercial development and intermingled small agricultural plots and undeveloped open space, similar to the area in and surrounding Cuyahoga Valley National Park.

In the early years of the plan, deer population would remain at relatively high levels and changes in deer movements as a result of the sharpshooting activities may temporarily increase the probability of being involved in a deer-vehicle collision, especially in and near the zones with the highest deer densities. As the population was reduced and deer reduction activities became less prevalent, however, a reduction in deer-vehicle collisions could be expected. Deer have most likely become accustomed to foraging on ornamental plantings and crops grown outside the park and would not cease to do so. However, the number of deer crossing the roads to reach these plantings and to get from one area of the park to another would decrease. The likelihood of being involved in a deer-vehicle collision would be expected to decrease proportionately with the reduction of the deer population. This would result in a long-term beneficial impact.

Lyme Disease

With an expected reduction in the deer population during the first few years of the plan, there would be anticipated reductions in tick populations within the park. Although the number of visitors and employees who have encountered a deer tick or acquired Lyme disease within the park is unknown, the likelihood of encountering a deer tick would be reduced, but not eliminated. While a reduction in deer density may

contribute to a reduction in deer ticks carrying Lyme disease, it is uncertain exactly how much of an effect would occur. Studies comparing natural variation in deer abundance with that in tick abundance have not been conclusive; some have shown strong associations (Wilson 1998; Stafford, DeNicola, and Kilpatrick 2003; Rand et al. 2003), whereas others have not (Lubelczyk et al. 2004; Jordan and Schulze 2005; Jordan, Schulze, and Jahn 2007). Mumford Cove, Connecticut, and Monhegan Island, Maine, are commonly cited as two places where the removal or drastic decrease in the deer population resulted in the near eradication of Lyme disease. It should be noted that Mumford Cove is located on a peninsula and is 132 acres in size, and the area of Monhegan Island is one square mile (640 acres); Cuyahoga Valley National Park is approximately 33,000 acres. Current understanding of Lyme disease dynamics does not allow an accurate prediction as to whether results obtained in one setting can be extrapolated to other areas with different ecological and geographical factors present. Therefore, the effects of deer reduction on Lyme disease prevalence cannot be determined, although it would be reasonable to assume that the chance for impacts should decrease proportionately with the reduction of the deer population and result in a long-term, beneficial impact from reducing the number of deer tick hosts.

Cumulative Impacts

The same past, present, and reasonably foreseeable future actions described under Alternative A would also occur under Alternative C, with beneficial and negligible to moderate adverse impacts and potential impacts on the health and safety of NPS staff and visitors. These impacts, when combined with the long-term negligible to minor adverse and long-term beneficial impacts of Alternative C, would result in long-term negligible adverse cumulative impacts on health and safety. Alternative C would contribute a minimal amount to the overall risks and would add several long-term benefits related to the reduction in deer numbers.

Alternative D: Combined Lethal and Nonlethal Actions

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative D. Lethal reduction would be implemented to reduce the deer population as described under Alternative C. Once the initial density goal is attained, reproductive control (as described in Alternative B) and lethal reduction (if needed) would be used to maintain the deer population at the reduced level. Similar to other all action alternatives, Alternative D would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Implementation of Deer Management Actions

Sharpshooting and capture and euthanasia would be implemented over the first four years of the plan to reduce the size of the deer herd. Reproductive controls would then be administered if feasible. Several actions would be taken to ensure the safe conduct of operations. Sharpshooting would primarily occur at night (between dusk and dawn) during late fall and winter months when deer are more visible and few visitors are in the park. In some areas sharpshooting might be conducted during the day, or at other times of year if needed to maximize effectiveness and minimize overall time of visitor restrictions. The park would comply with all federal firearm laws administered by the ATF. Areas could be temporarily closed to park visitors and NPS park rangers would patrol public areas to ensure compliance with park closures and public safety measures. The public would be notified of any park closures in advance. Information regarding deer management would be displayed at visitor contact facilities, and information would be posted on the park’s website to inform the public of deer management actions. These actions would increase the potential risk of employee injury due to the use of firearms and the need to capture and

euthanize some deer. However, safety precautions taken by park staff would offset these risks, as described under Alternative C.

Similar to Alternative C, capturing and euthanizing deer could affect visitor safety. It is unlikely that visitors would be exposed to such action, which would occur primarily at dawn or dusk. If this method were required to remove multiple deer, the area would be temporarily closed to visitors. Therefore, overall impacts on visitors and employees would be adverse, long-term, and negligible to minor.

Deer-Vehicle Collisions

As noted under the discussion for Alternative C, although the direct relationship is unknown, research suggests that a decrease in the local deer population could reduce the number of deer-vehicle collisions (Curtis et al. 2002), and other research supports this (DeNicola and Williams 2008). This decrease would not be realized in the early years of the plan, as the deer population would remain at high levels and changes in deer movements as a result of the sharpshooting activities may temporarily increase the probability of being involved in a deer-vehicle collision. As the population was reduced and deer reduction activities became less prevalent, however, a reduction in deer-vehicle collisions could be expected. The likelihood of being involved in a deer-vehicle collision would be expected to decrease proportionately with the reduction of the deer population. This would result in a long-term beneficial impact.

Lyme Disease

As described for Alternative C, with an expected reduction in the deer population during the first few years of the plan, there would be anticipated reductions in tick populations within the park. Although the number of visitors and employees who have encountered a deer tick or acquired Lyme disease within the park is unknown, the likelihood of encountering a deer tick would be reduced but not eliminated. The effects of deer reduction on Lyme disease prevalence cannot be determined, although it would be reasonable to assume that the chance for impacts should decrease proportionately with the reduction of the deer population and result in a long-term, beneficial impact from reducing the number of deer tick hosts.

The overall impact of Alternative D on visitor and employee health and safety would be long-term, adverse and negligible with beneficial impacts in several areas of risk due to the reduction in deer density.

Cumulative Impacts

The same past, present, and reasonably foreseeable future actions described under Alternative A would also occur under Alternative D, with beneficial and negligible to moderate adverse impacts and potential impacts on the health and safety of NPS staff and visitors. These impacts, when combined with the long-term negligible to minor adverse and long-term beneficial impacts of Alternative D, would result in long-term negligible adverse cumulative impacts on health and safety. Alternative D would contribute a minimal amount to the overall risks and would add several long-term benefits related to the reduction in deer numbers.

4.10.5 CONCLUSION

Alternatives A or B would result in long-term, adverse impacts on visitor and employee health and safety that range from negligible to potentially major depending on the source and outcome of accident. Alternatives A and B would result in long-term moderate adverse cumulative impacts on visitor and employee health and safety. Alternatives A and B would contribute considerably to the overall adverse

cumulative impacts because of the higher potential for deer-vehicle collisions and possibly Lyme disease transmission. This would be due to the lack of reduction in the deer population during the life of this plan under either alternative. Alternatives C and D would result in long-term negligible to minor adverse impacts on visitor and employee health and safety with beneficial impacts in several areas of risk due to the reduction in deer density. Cumulative impacts of Alternatives C and D on visitor and employee health and safety would be long-term negligible adverse. Alternatives C and D would contribute a minimal amount to the overall risks and would contribute considerable benefits to the overall cumulative impact.

4.11 IMPACTS ON PARK MANAGEMENT AND OPERATIONS

4.11.1 GUIDING REGULATIONS AND POLICIES

Park management and operations refers to the current staff available to adequately protect and preserve park resources and provide for an effective visitor experience. This topic also includes the operating budget necessary to conduct park operations.

4.11.2 ASSUMPTIONS, METHODOLOGIES, AND INTENSITY DEFINITIONS

The discussion of impacts on park operations focuses on (1) the amount of staff available to ensure visitor and employee safety, and (2) the ability of park staff to protect and preserve resources given current funding and staffing levels. It was assumed under all alternatives that the park's annual budget would be increased to implement a particular alternative. However, this funding is not guaranteed. Park staff knowledge was used to evaluate the impacts of each alternative, and the evaluation is based on the description of park management and operations presented in Chapter 3. Definitions of impact levels are as follows:

Negligible: There would be no discernible effects on park management and operations.

Minor: There would be detectable effects on park management and operations, noticeable by some park staff, but probably not noted by visitors. Current staffing and funding levels would not change, but priorities may need to be changed.

Moderate: There would be readily apparent effects on park management and operations, but probably not noted by most visitors. Increases or decreases in staffing and funding would be needed and changes in work assignments or priorities would be required.

Major: There would be substantial changes to park management and operations, apparent to both staff and the public. Increases or decreases in staff and funding would be needed and/or other park programs would have to be substantially changed or eliminated.

4.11.3 AREA OF ANALYSIS

The area of analysis, including the cumulative impacts analysis, is Cuyahoga Valley National Park.

4.11.4 IMPACTS OF THE ALTERNATIVES

Alternative A: No Action Alternative (Continuation of Existing Management)

Analysis

Under Alternative A, park staff would continue to monitor the deer population and vegetation and continue to use tree tubes or small-scale fencing to protect small areas of restored tree plantings. It is expected that the park's deer population would continue at relatively high levels, although numbers would fluctuate annually due to winter temperatures, snow depths and duration, food availability, reproduction and mortality rates due to herd health, and other factors. Existing park staff would be sufficient to continue performing current deer management functions at the present population level. However, it is expected that additional efforts by park staff would be required for implementation of other resource activities, such as control of nonnative plants or reestablishment of native vegetation due to the continued high density. Natural resource management staff currently devote about 10 to 15 percent of their time to deer management Under the no action alternative, additional management responsibilities, as well as any additional funding that might be needed to build and maintain additional fencing and install restoration planting protections would result in long-term, minor adverse impacts.

Under this alternative, park staff would also monitor the costs of the deer management program, including costs related to staff time, training, administrative, legal, public relations, and monitoring. If deer management costs increase substantially, funds and personnel from other park divisions might have to be reallocated (e.g., from administration and maintenance), resulting in adverse, long-term, minor impacts to other divisions. There would be negligible adverse impacts on park operations from educational and coordination activities, as there are sufficient funds and personnel to run these activities, incorporating deer management, and present funding and staffing are expected to continue

Cumulative Impacts

Several past, present, and reasonably foreseeable future actions would contribute to the cumulative impact on park management and operations at Cuyahoga Valley National Park, including deer management and land development outside the park, as well as and park management, operations, and maintenance and land acquisition. Coordination with outside agencies related to deer management would continue, and the effects of deer removals could decrease the number of deer within the park boundary, reducing deer damage and possibly creating a slight long-term benefit to park staff. Land development outside the park and increased visitation would result in increased traffic on park roadways and require staff time and resources to deal with road maintenance, accident response, and visitor needs and inquiries. These demands result in long-term, minor adverse impacts to park operations. Land acquisition would add more areas requiring park oversight and maintenance, a long-term minor adverse effect. Increased pressure from other recreational uses and implementation of the park's Trail Plan would also place additional demands on park staff, contributing long-term minor adverse impacts.

The mostly minor adverse impacts of the above actions, when combined with the long-term negligible to minor adverse impacts of Alternative A related to the expected demands of deer management, would result in long-term minor adverse cumulative impacts on park management and operations. Alternative A would contribute slightly to the overall adverse cumulative impacts because of the continued demand for deer management activities and coordination.

Alternative B: Combined Nonlethal Actions

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative B. In addition, large-scale exclosures would be constructed and rotated for the purposes of forest regeneration. Non-surgical reproductive control would be used to reduce the deer population. Similar to other action alternatives, Alternative B would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Similar to Alternative A, deer populations would continue to remain at high levels, pending the implementation of reproductive controls, and numbers would likely continue to fluctuate annually. The non-lethal management measures outlined under Alternative B would require additional staff time and seasonal staff, for which additional funding would be needed. Additional temporary staff would likely be needed for the initial construction of the large enclosures and construction of additional monitoring sites. If staff from other park divisions were used, park operations in those divisions would be adversely affected during the construction period.

In addition to an increase in temporary staffing, additional funding would be required, as the initial cost of installing the 30 exclosures would be approximately $720,000 for supplies and labor. After the initial construction, the exclosures would be relocated and inspected and maintained, at an estimated annual cost of $26,000 for supplies and labor. Furthermore, to reduce impacts to visitors as much as possible, some exclosures would be located in more remote areas of the park, adding to maintenance costs. These costs would be in addition to the park's present budget and would result in increased funding needs, with adverse, long-term, moderate impacts.

Alternative B would include reproductive control of does, with 90 percent of does treated every 2 years, at an estimated cost of $6,008,000 over the life of the plan. Costs for continued reproductive control would depend on the number of deer treated and the current available technology. Assuming the use of GonCon™ (or similar agent) as described in Chapter 2, costs would be approximately $1,000 per deer. If 751 does are treated, the cost for each treatment would total $751,000, with $1,250 yearly monitoring costs. This is about two-thirds of the current annual operating budget of the Resource Management Division of $1,179,110. Labor for the reproductive control efforts would be provided by qualified federal employees or authorized agents. The additional funds needed for implementing reproductive control of does with current technology would likely result in adverse, long-term, major adverse impacts to the park budget because of the large amount of time and labor involved, most likely reducing the time available for other efforts.

As discussed in Chapter 2, the nearest currently-known case of CWD is well over 60 miles from the park (200 miles). Under all action alternatives, park staff would engage in opportunistic surveillance on available deer carcasses as needed. If CWD is found within 60 miles of the park, the park would perform both opportunistic and targeted surveillance as a component of this and other action alternatives. Park employees or authorized agents would be trained to recognize and report deer exhibiting clinical symptoms of CWD, to monitor deer exhibiting clinical symptoms, and to implement the targeted surveillance consistent with NPS guidance. Under targeted surveillance, the park would increase coordination with state agencies such as ODNR. The park is not currently taking any actions related to CWD surveillance. The result of these actions would be a long-term, minor adverse impact on park management and operations.

This alternative would also involve increased educational and interpretive activities, and would therefore require additional funding and/or additional staff time to implement these activities. Increased responses to inquiries about the actions taken under this alternative would likely increase the workload of park biologists, rangers, and the Superintendent. This would result in moderate adverse impacts to resource education and resource protection staff, which would decline to minor levels over time.

Cumulative Impacts

The same past, present, and reasonably foreseeable future actions described under Alternative A would also occur under Alternative B, with minor adverse impacts on the park management and operations. These impacts, when combined with the long-term minor to major adverse impacts of Alternative B, would result in long-term moderate to possibly major adverse cumulative impacts on park management and operations. Alternative B would contribute considerably to the overall adverse cumulative impacts because of the higher demands for staff time and the high costs associated with reproductive control and exclosure construction and maintenance.

Alternative C: Combined Lethal Actions (Sharpshooting and Capture/Euthanasia)

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative C. In addition, sharpshooting would be used under this alternative to reduce the deer population, along with capture and euthanasia in circumstances where sharpshooting would not be appropriate. Similar to other action alternatives, Alternative C would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

The existing deer population would be reduced over a period of about four years to about 21-22 deer per square mile, within the desired range of 15 to 30 deer per square mile. Additional deer would be removed in subsequent years to maintain the population. The addition of these lethal management measures would require additional staff time to accompany the qualified federal employees or authorized agents conducting sharpshooting activities, as well as the cost of the agents themselves. Removal activities would require obtaining permits, setting up bait stations, locating deer, sharpshooting, and handling the disposition of meat. In addition to the actual reduction activity, time would be required to coordinate the details of the reduction activity internally and with outside organizations.

Costs to the park for direct reduction through sharpshooting would vary, depending on a number of factors, including the number of deer to be removed each year, access to deer, number and location of bait stations, training requirements, equipment availability, amount of data to be collected from the deer, and processing or disposal requirements. Based on similar removal efforts, the estimated cost for the park to implement direct reduction through sharpshooting would be $200 per deer initially, increasing to $400 per deer as the population decreased and more effort was required to locate deer, including actions to maintain the herd at the reduced level once the initial goal was achieved. Over the 15-year planning period for the deer management plan, sharpshooting efforts are estimated to cost approximately one million dollars, with annual costs at about $70,000 to $72,000, about 6 percent of the current annual operating budget of the Resource Management Division of $1,179,110. The majority of project funding, including all deer reduction activities and management of these, would be the responsibility of the park. Any assistance offered by the park’s staff would be considered part of regular duties, rather than project specific, and would not require additional project funding. Due to the amount of time required by park staff to participate in these activities and the funding increase that would need to be applied for, impacts would be adverse and moderate during the period of the reduction efforts.

Where direct reduction by sharpshooting was not possible due to safety concerns (e.g., near adjacent properties), capture and euthanasia would be implemented by qualified federal employees or authorized agents. Because this method would only be used in certain situations, the cost would vary depending on the conditions at each removal site, including the location of the removal, accessibility, type of trap or immobilization drug used, how deer were disposed of, and the type of euthanasia used. Based on the range of costs identified for capturing deer under the reproductive control action, the costs could range from $100 to $1,000 per deer, and an average of about $500 per deer was assumed for costing purposes. This action would require increased funding and result in adverse, long-term, moderate impacts.

As part of this alternative, both deer population studies and vegetation monitoring would be conducted to document any changes in deer browsing and forest regeneration that may result from reduced deer numbers. This monitoring program would continue after the density goals were reached to determine if vegetation was showing signs of recovery. This monitoring would be similar to current park efforts that are already scheduled to continue and would result in long-term minor impacts to park operations and maintenance.

The impacts of CWD on park management and operations would depend on the number of deer carcasses available for testing and the distance of the nearest confirmed case of CWD from the park and the required level of surveillance (i.e., >60 miles requires opportunistic surveillance, while <60 miles requires opportunistic and targeted surveillance). Opportunistic surveillance would have a minor adverse impact and should targeted surveillance be necessary, it would have a moderate adverse impact on park management and operations given the greater number of opportunities available for testing on this alternative compared to Alternative B.

This alternative would also involve increased educational and interpretive and management activities, and would therefore require additional funding and/or additional staff time to implement these activities. This would result in moderate adverse impacts to resource education and resource protection staff. Moderate adverse impacts could also be expected due to time needed to answer public inquiries about the actions taken, especially if visitors have conflicting opinions about using sharpshooting or any lethal means for reduction and require additional attention. This need would likely decline over the years, and adverse impacts would be expected to decline to minor levels over time.

Cumulative Impacts

The same past, present, and reasonably foreseeable future actions described under Alternative A would also occur under Alternative C, with minor adverse impacts. These impacts, when combined with the long-term minor to moderate adverse impacts of Alternative C, would result in long-term moderate adverse cumulative impacts on park management and operations. Alternative C would contribute a moderate amount to the overall adverse effects due to the costs and demands associated with lethal removal.

Alternative D: Combined Lethal and Nonlethal Actions

Analysis

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under Alternative A would continue under Alternative D. Lethal reduction would be implemented to reduce the deer population as described under Alternative C. Once the initial density goal is attained, reproductive control (as described in Alternative B) and lethal reduction (if needed) would be used to maintain the deer population at the reduced level. Similar to other all action

alternatives, Alternative D would also include additional vegetation monitoring plots and the opportunistic surveillance of deer for CWD.

Costs to the park for sharpshooting would vary from $200 to $400 per deer, as described under Alternative C, and would occur in the first four years of the plan, as a cost of $72,000 per year. The majority of project funding, including all deer reduction activities, and management of these, would be the responsibility of the park. Any assistance offered by the park's staff would be considered part of regular duties. Impacts are expected to be adverse, long-term, and moderate.

Where direct reduction by sharpshooting was not possible due to safety concerns, capture and euthanasia would be implemented by qualified federal employees or authorized agents. As described under Alternative C, the costs would average about $500 per deer, but could vary based on situation conditions. Although limited staff time would be required since actions would be carried out by qualified federal employees or authorized agents, park staff would be involved in coordinating activities and an increase in funding would be required, resulting in adverse, long-term, moderate impacts.

After the initial reduction in density, Alternative D would use reproductive control of the park's deer population by the methods described under Alternative B if feasible. Costs for reproductive control are estimated at $471,000 every 2 years, starting in year 5, assuming treatment of 471 does plus an annual $1,250 cost for reproduction monitoring in years 6 through 15. This is about 40 percent of the current annual operating budget of the Resource Management Division of $1,179,110. Park staff would need to spend additional time and labor to coordinate and monitor activities, resulting in adverse, long-term, moderate impacts.

The impacts of CWD on park management and operations would depend on the number of deer removed and available for testing and the distance of the nearest confirmed case of CWD from the park and the associated level of surveillance required. Impacts would be similar to those under Alternative C, with potentially fewer opportunities available under the maintenance stage.

This alternative would also involve increased educational and interpretive activities, and would therefore require additional funding and/or additional staff time to implement these activities. There would be moderate adverse impacts to resource education and visitor protection staff as a result, which would decline to minor adverse levels over time.

Overall, the combination of non-lethal and lethal management alternatives and the associated educational/interpretive activities would have adverse, long-term, moderate impacts to park management and operations during the period of direct reduction and reproductive control. Once the deer herd was reduced, more staff time would be available for other activities, resulting in adverse, long-term, minor impacts.

Cumulative Impacts

The same past, present, and reasonably foreseeable future actions described under Alternative A would also occur under Alternative D, with long-term minor adverse impacts. These impacts, when combined with the long-term minor to moderate adverse impacts of Alternative D, would result in long-term moderate adverse cumulative impacts on park management and operations. Alternative D would contribute a moderate amount to the overall adverse effects due to the costs and demands associated with lethal removal and reproductive control after year 5.

4.11.5 CONCLUSION

Alternative A would result in long-term minor adverse impacts. Because present deer management actions would continue, the park's deer population is expected to continue to fluctuate and remain at high levels, resulting in long-term demands on park staff and funding for managing the deer herd and protecting other park resources. Alternative A would have long-term minor adverse cumulative impacts. Alternative A would contribute slightly to the overall adverse cumulative impacts because of the continued demand for deer management activities and coordination cumulative impacts.

Alternative B would result in long-term moderate to potentially major adverse impacts on park management and operations. These impacts would be caused by installing and maintaining large exclosures and implementing and monitoring reproductive controls. Minor adverse impacts would result from increased educational/interpretive activities and CWD surveillance. Cumulative impacts would be long-term, moderate to possibly major adverse, and Alternative B would contribute considerably to the overall adverse cumulative impacts because of the higher demands for staff time and the high costs associated with reproductive control and exclosure construction and maintenance.

Alternative C would result in moderate adverse impacts during the period of direct reduction efforts because of the need for additional staff time for monitoring and coordinating activities. The use of qualified federal employees or authorized agents would reduce the amount of park staff time needed for implementation, but would still result in increased costs. With the greater reduction of deer over a shorter period of time, park staff would have more time to apply their efforts to other areas of the park when compared to Alternative A, which would reduce adverse, long-term impacts from moderate to minor over time. Cumulative impacts would be long-term, moderate, adverse, and Alternative C would contribute a moderate amount to the overall adverse effects due to the costs and demands associated with lethal removal.

Alternative D would result in moderate adverse impacts because park staff involvement would be required for coordination and monitoring of the reduction and reproductive control actions. Once the deer herd was reduced, more staff time would be available for other activities, resulting in adverse, long-term, minor impacts. Cumulative impacts would be long-term, moderate, adverse, and Alternative D would contribute a moderate amount to the overall adverse effects due to the costs and demands associated with lethal removal and reproductive control after year 5.

4.12 UNAVOIDABLE ADVERSE IMPACTS

The NPS is required to consider if the alternative actions would result in impacts that could not be fully mitigated or avoided (NEPA Section 101[c][ii]).

4.12.1 ALTERNATIVE A: NO ACTION (CONTINUE EXISTING MANAGEMENT)

Under Alternative A, there would be long-term, unavoidable adverse impacts to vegetation, deer and other wildlife, and possibly certain special-status species due to the continued high number of deer expected in the park over time and the associated damage to park vegetation. This includes unavoidable adverse impacts to those wildlife species that depend on ground cover and forest breeding species that rely on understory for nesting or for foraging on insects and other prey. There would also be long-term unavoidable adverse impacts on visitor use and experience, because of the reduced vegetation and the associated wildlife and scenery which many park visitors enjoy, as well as adverse effects on rural landscapes because of the changes to vegetation and patterns seen. Unavoidable adverse impacts to safety related to deer-vehicle collisions would continue, and there would be a continued contribution to adverse effects related to the transmission of Lyme disease. Unavoidable adverse impacts would continue on park

management and operations, due to the demand on park staff related to continued deer monitoring and resource management.

4.12.2 ALTERNATIVE B: COMBINED NON-LETHAL ACTIONS

Alternative B would include most of the unavoidable adverse impacts described for Alternative A over the life of the plan, since the benefits of reproductive control would not be realized until much later, given the length of time needed to realize a reduction in deer herd numbers based solely on reproductive control. Unavoidable adverse effects may occur to other wildlife species affected by the exclosures. Unavoidable adverse impacts may occur to some special-status plant species due to the continued high numbers of deer and their browsing; this would be mitigated somewhat by the use of the exclosures, however. Reproductive control may have some unavoidable adverse impacts if the actions taken were visible or disturbing to park visitors. Providing interpretive materials may help mitigate some of this effect, and most of these actions would occur during lower use periods in late fall and winter. Unavoidable adverse impacts to park operations and management would increase compared to Alternative A, due to the demands on staff for implementation of the program.

4.12.3 ALTERNATIVE C: LETHAL ACTIONS (SHARPSHOOTING AND CAPTURE/EUTHANASIA)

Unavoidable adverse impacts for this alternative would be greatly reduced compared to Alternatives A and B, because the reduction in deer numbers would occur rapidly and the park's vegetation would begin to recover over the life of the plan. This would mitigate adverse effects to vegetation, deer and other wildlife, and several special-status species. Some wildlife that prefer more open or grassland habitat would be unavoidably impacted as the vegetation recovered. There may be some unavoidable adverse effects to visitors relating to the implementation of the sharpshooting or capture and euthanasia, if the visitors happened to be near areas where this was occurring and/or were disturbed by these actions. Conducting sharpshooting at night and providing interpretive materials would help mitigate some adverse effects. Unavoidable adverse impacts to park operations and management would increase compared to Alternative A, due to the demands on staff for implementation of the program.

4.12.4 ALTERNATIVE D: COMBINED LETHAL AND NONLETHAL ACTIONS

Unavoidable adverse impacts for this alternative would be essentially the same as those described for Alternative C, although use of reproductive controls for long-term maintenance of the deer herd would involve a greater commitment of staff and resources and result in greater unavoidable adverse impacts to park management and operations.

4.13 SUSTAINABILITY AND LONG-TERM MANAGEMENT

In accordance with NEPA, and as further explained in Director's Order 12, consideration of long-term impacts and the effects of foreclosing future options should pervade any NEPA document. According to Director's Order 12, and as defined by the World Commission on Environment and Development, "sustainable development is that which meets the needs of the present without compromising the ability of future generations to meet their needs." For each alternative considered in a NEPA document, considerations of sustainability must demonstrate the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity. This is described below for each alternative.

The NPS must consider if the effects of the alternatives involve tradeoffs of the long-term productivity and sustainability of park resources for the immediate short-term use of those resources. It must also consider if the effects of the alternatives are sustainable over the long term without causing adverse environmental effects for future generations (NEPA Section 102[c][iv]).

4.13.1 ALTERNATIVE A: NO ACTION ALTERNATIVE (CONTINUE EXISTING MANAGEMENT)

Alternative A would trade any long-term productivity for short-term use of park resources. The deer population would likely continue to grow over time or remain at high levels especially in certain zones of the park, and use the park's vegetation at the expense of the long-term productivity and sustainability of the vegetation and other affected wildlife in the park, as well as the park's rural landscapes.

4.13.2 ALTERNATIVE B: COMBINED NONLETHAL ACTIONS

Alternative B would involve a similar trade for short-term use of park resources at the expense of long-term productivity for the duration of the plan, since the reproductive controls would not reduce the numbers of deer in the park over the life of the plan. The construction of the exclosures would involve short-term impacts related to their construction and visual impacts to visitors, but they would help preserve some of the park's long-term productivity. They would only protect a small portion of the park's woody vegetation over time, and only 5 percent of the park's herbaceous vegetation at any one time. For this alternative to be truly sustainable, the reproductive control aspect must be continually managed and successful, and exclosures would need to be relocated to many areas of the park over time.

4.13.3 ALTERNATIVE C: LETHAL ACTIONS (SHARPSHOOTING AND CAPTURE/EUTHANASIA)

Under Alternative C, there would be a short-term commitment of human resources and short-term impacts to the park's visitors and environment during deer removal actions, but with the result of long-term productivity of the park's vegetation and habitat and a sustainable use of the resources in the park. To be sustainable, this alternative will require long-term management, including monitoring and adaptive management to protect park productivity.

4.13.4 ALTERNATIVE D: COMBINED LETHAL AND NONLETHAL ACTIONS

Alternative D would have the same long-term sustainability characteristics as Alternative C, except that it would require more resources focused on the reproductive control aspect, since it is experimental in a free-ranging population.

4.14 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

The NPS must consider if the effects of the alternatives cannot be changed or are permanent (that is, the impacts are irreversible). The NPS must also consider if the impacts on park resources would mean that once gone, the resource could not be replaced; in other words, the resource could not be restored, replaced, or otherwise retrieved (NEPA Section 102[c][v]).

4.14.1 ALTERNATIVE A: NO ACTION ALTERNATIVE (CONTINUE EXISTING MANAGEMENT)

Under Alternative A, impacts to vegetation (particularly the forest understory and herbaceous ground cover) from continued overbrowsing by deer could result in irreversible impacts to Cuyahoga Valley National Park forests if no actions are ever taken to reduce deer numbers. Exotic plants that are not palatable to deer would continue to exploit openings in the understory, and animal species that rely on native ground vegetation might not remain in or return to areas of the park if the forest understory does not regenerate. Deer browsing has already resulted in the reduction of understory plant species. Even if fencing were used to protect some of the special-status species, it would be impossible to identify all individual plants, and overbrowsing of new plants located outside the fenced areas could occur. In addition, the deer population could suffer irretrievable adverse health effects if no action is taken.

4.14.2 ALTERNATIVE B: COMBINED NONLETHAL ACTIONS

Alternative B has the potential for some irreversible impacts, if some areas of the park's forests are adversely affected to the point of nonregeneration or if invasive exotic plants take over some denuded areas before reproductive controls have had time to stabilize the deer herd numbers. Exclosures will not cover the entire park, and so some of the irreversible impacts described for Alternative A would likely occur under Alternative B as well.

4.14.3 ALTERNATIVE C: LETHAL ACTIONS (SHARPSHOOTING AND CAPTURE/EUTHANASIA)

This alternative presents the least potential for irreversible or irretrievable commitments of resources. Although deer would be removed, the deer population would continue at a sustainable level. Because the herd would be reduced rapidly, there would be little chance that park vegetation (including certain special-status species) or other species that are dependent upon forest understory and native ground cover would be irretrievably lost, since forest regeneration would begin within the life of the plan.

4.14.4 ALTERNATIVE D: COMBINED LETHAL AND NONLETHAL ACTIONS

This alternative is essentially the same as Alternative C, with very little potential for irreversible or irretrievable commitments of resources. Because the herd would be reduced rapidly, there would be little chance that park vegetation (including certain special-status species) or other species that are dependent upon forest understory and native ground cover would be irretrievably lost, since forest regeneration would begin within the life of the plan.

Chapter 5

Consultation and Coordination

CHAPTER 5: CONSULTATION AND COORDINATION

One intent of NEPA is to encourage the participation of federal and state-involved agencies and affected citizens in the assessment procedure, as appropriate. This section describes the consultation that occurred during development of this plan/EIS, including consultation with scientific experts and other agencies. This chapter also includes a description of the public involvement process and a list of the recipients of the draft document.

5.1 HISTORY OF PUBLIC INVOLVEMENT

The public involvement activities for this plan/EIS fulfill the requirements of NEPA and NPS Director's Order 12 (NPS 2011k).

5.1.1 THE SCOPING PROCESS

The NPS divides the scoping process into two parts: internal scoping and external or public scoping. Internal scoping involved discussions among NPS personnel regarding the purpose of and need for management actions, issues, management alternatives, mitigation measures, the analysis boundary, appropriate level of documentation, available references and guidance, and other related topics.

Public scoping is the early involvement of the interested and affected public in the environmental analysis process. The public scoping process helps ensure that people have an opportunity to comment and contribute early in the decision-making process. For this plan/EIS, project information was distributed to individuals, agencies, and organizations early in the scoping process, and people were given opportunities to express concerns or views and to identify important issues or even other alternatives.

Taken together, internal and public scoping are essential elements of the NEPA planning process. The following sections describe the various ways scoping was conducted for this plan/EIS.

5.1.2 INTERNAL SCOPING

The internal scoping process began on October 23, 2003, at Cuyahoga Valley National Park in Ohio. During 2 days of meetings, NPS employees identified the initial purpose, need, and objectives for managing deer at the park, and identified issues and concerns associated with the current deer populations and their impact on the park ecosystem. Preliminary alternatives were also discussed. Additionally, Cuyahoga Valley National Park convened a science team consisting of scientists and other specialists from a variety of state and federal government organizations to help define components of the planning process (members of the science team are listed later in this chapter). As described in "Chapter 1: Purpose of and Need for Action," the team evaluated scientific literature and research on the topic of deer management, established a monitoring protocol for park deer populations and other park resources, and established a basis for the resource thresholds at which deer management strategies would be implemented. The first science team meeting was held on February 23, 2006, and meetings occurred periodically thereafter over the next year, providing technical background information and research references for this plan.

A second internal scoping meeting was held on February 22, 2006, during which the planning team reaffirmed the purpose of and need for the plan, incorporating the latest information available, and discussed impact topics and alternative options, including alternatives considered but dismissed. Additional public input was emphasized and public meeting plans were initiated.

The planning team met again on March 14 and 15, 2007, to select and develop the alternatives that are considered in this plan/EIS. The group reviewed the management strategies and alternative options that were developed during internal scoping and discussed during the public meetings that were held in October 2006 (see "Public Scoping").

All internal scoping and science team meetings are documented in reports that are available in the administrative record for this plan/EIS.

5.1.3 PUBLIC SCOPING

Public scoping efforts for this planning process focused on efforts to include the public, the major interest groups, and local public entities. NPS staff places a high priority on meeting the public involvement requirements of NEPA and giving the public an opportunity to comment on proposed actions.

Public Notification

An NOI to prepare an EIS was published in the Federal Register on September 6, 2006 (Volume 71, Number 172).

A brochure was mailed in September 2006 to the project's preliminary mailing list of government agencies, tribes, organizations, businesses, and individuals. The brochure announced public scoping meetings to be held in October 2006, summarized the purpose of and need for the plan, listed preliminary alternatives, provided background information on deer monitoring and research and findings at the park, and presented instructions on how to comment on the plan.

Press releases were issued from the park on September 13, 2006, to announce publication of the NOI in the Federal Register, and on October 4, 2006, to announce the dates/times for the public meetings. The first release resulted in articles and interviews in three newspapers and three radio stations. In addition, a media alert was issued on September 29, 2006, to invite the media to a briefing prior to the public meetings. On October 4, 2006, members of the media were given a preview of the public slide presentation and were taken on a tour of a deer exclosure monitoring site. Attendees at this event included reporters from two local newspapers, three radio stations, and two television stations. Media contacts during this scoping period included the following:

- Akron Beacon Journal
- Record Publishing
- Sun Newspapers
- The Plain Dealer
- West Side Leader
- 89.7 WKSU-FM
- 90.3 WCPN Ideastream
- 100.1 WNIR
- WAKR
- Clearchannel Radio
- Ohio News Network

- Channel 3 WKYC (NBC affiliate)
- Fox 8 News

Public Meetings

On October 11 and 12, 2006, the NPS held three public scoping meetings for the plan/EIS. One meeting was held on October 11 and two meetings were held on October 12. The purpose of the scoping meetings was to begin public involvement early in the planning stage and to obtain community feedback on the initial concepts for deer management at Cuyahoga Valley National Park. The meetings were held in an open-house format and included a brief presentation and display boards that illustrated the project background; draft purpose, need, and objectives; park research; and preliminary concepts for deer management at the park.

At the meetings, NPS personnel or contractors were available to answer questions or concerns of community members and to record comments. Comment sheets were also provided to meeting attendees as an additional method for providing comments. Additionally, meeting attendees were directed to the EIS brochure, which provided information on other opportunities to comment on the project, including submitting comments through the NPS Planning, Environment, and Public Comment (PEPC) website at http://parkplanning.nps.gov/cuva. During the three meetings, a total of 91 attendees signed in.

Public Comment

The 60-day public comment period began with publication of the NOI to prepare an EIS in the Federal Register on September 6, 2006. In total, the NPS received 225 pieces of correspondence, representing 441 comments. A “piece of correspondence” is used to describe the entire document submitted by the commenter. A “comment” is a portion of the text within a piece of correspondence that addresses a single subject. In addition to comments received at the public scoping meetings from attendees, the NPS received comments from individuals and organizations not present at the meetings by means of mail, email, and the PEPC website. The NPS read all correspondence and specific comments within each piece of correspondence were identified and grouped by similar topic. Public comments were analyzed and a public scoping comment analysis report was created, which is now on file as part of the administrative record.

Commenters provided numerous suggestions for elements that could be incorporated into the preliminary alternatives. A large portion of such comments addressed reproductive control. Among such comments were proposals for conducting contraceptive research, suggestions for a variety of ways to administer reproductive control, and concerns over the effectiveness of contraception. A number of comments also requested that public safety be taken into consideration in the plan/EIS. Specific concerns were related to damage to property, the possibility of human injury if the alternative involves shooting, and the danger related to bucks during the rut.

The most frequently addressed topic in the public’s comments was public hunting for deer management at the park. Many commenters requested that the NPS consider a public hunt as one of the alternatives in the plan/EIS and offered numerous possible variations on a public hunt alternative. Commenters also provided numerous suggestions for elements that could be incorporated into the preliminary action alternatives.

5.2 AGENCY CONSULTATION

The park contacted several agencies and tribal nations at the beginning of this project and included them in their mailing list for notice of the public meetings that were held in October 2006. The U.S. Fish and Wildlife Service was contacted about the presence of federally listed rare, threatened, or endangered species in or near the park, which began informal consultation under Section 7 of the ESA. The Ohio Department of Natural Resources was similarly contacted for information on state-listed species. The Ohio Historical Society and State Historic Preservation Officer were contacted to initiate consultation per Section 106 of the National Historic Preservation Act. Informal consultation was also initiated with the following tribes: Absentee-Shawnee Tribe of Indians of Oklahoma, Delaware Tribe of Indians, Delaware Tribe of Western Oklahoma, Eastern Shawnee Tribe of Oklahoma, Miami Tribe of Oklahoma, Ottawa Tribe of Oklahoma, Seneca Nation of Indians, Seneca-Cayuga Tribe of Western Oklahoma, Shawnee Tribe, and Wyandotte Nation. One representative from the Delaware Nation submitted a comment following the public meeting, indicating that they would gladly participate as a consulting party and would review the draft EIS when it is complete. A copy of this draft plan/EIS will be sent to all the agencies and tribes contacted to solicit further comment.

5.3 LIST OF RECIPIENTS OF THE DRAFT PLAN/ENVIRONMENTAL IMPACT STATEMENT

This plan/EIS will be sent to the following agencies, organizations, and businesses, as well as to other entities and individuals who have requested a copy.

Ohio Congressional Delegation:

- Senator Sherrod Brown
- Senator Rob Portman
- Representative Dennis Kucinich
- Representative Marcia Fudge
- Representative Betty Sutton
- Representative Steven LaTourette
- Representative Timothy Ryan

Federal Agencies:

- National Park Service–Rivers, Trails & Conservation Assistance
- U.S. Department of Agriculture–APHIS Wildlife Services
- U.S. Department of Agriculture–Forest Service
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- U.S. Geological Survey

Tribal Nations:

- Absentee-Shawnee Tribe of Indians of Oklahoma
- Delaware Tribe of Indians
- Delaware Tribe of Western Oklahoma
- Eastern Shawnee Tribe of Oklahoma
- Miami Tribe of Oklahoma
- Ottawa Tribe of Oklahoma
- Seneca Nation of Indians
- Seneca-Cayuga Tribe of Western Oklahoma
- Shawnee Tribe
- Wyandotte Nation

State Legislative Delegation:

- Senator Kevin Coughlin
- Senator Thomas Patton
- Senator Thomas Sawyer
- Representative Josh Mandel
- Representative Brian Williams
- Representative Mike Moran
- Representative Vernon Sykes

State Agencies:

- Ohio Department of Agriculture
- Ohio Environmental Protection Agency
- Ohio Department of Natural Resources
- Ohio Historical Society (State Historic Preservation Officer)

Local Governments:

- Bath Township
- Boston Township
- City of Akron
- City of Bedford
- City of Brecksville
- City of Cuyahoga Falls
- City of Fairlawn

- City of Hudson
- City of Independence
- Cleveland Metroparks
- Cuyahoga County Board of Commissioners
- Cuyahoga County Planning Commission
- Cuyahoga Soil & Water Conservation District
- Metro Parks, Serving Summit County
- Northfield Center Township
- Richfield Township
- Sagamore Hills Township
- Summit County Planning Commission
- Summit Soil & Water Conservation District
- Village of Boston Heights
- Village of Peninsula
- Village of Richfield
- Village of Valley View
- Village of Walton Hills

Organizations and Agencies:

- Akron Garden Club
- American Farmland Trust
- Animal Protection Institute–Legal and Government Affairs
- Astorhurst Country Club
- Audubon Ohio
- Blossom Music Center
- Boston Hills Country Club
- Boston Mills/Brandywine Ski Resorts
- Boy Scouts of America
- Brandywine Country Club
- Carriage Trade Farm
- Center for Farmland Preservation in Northeast Ohio
- Church in the Valley
- Cleveland State University–Environmental Institute
- Crooked River Herb Farm

- Crown Point Ecology Center
- Cuyahoga River Remedial Action Plan
- Cuyahoga Valley Communities Council
- Cuyahoga Valley Countryside Conservancy
- Cuyahoga Valley National Park Association
- Cuyahoga Valley Scenic Railroad
- Cuyahoga Valley Trails Council
- Cuyahoga Valley National Park Association–Environmental Education Center
- Friends of Metro Parks
- Friends of the Crooked River (& Ohio Greenways)
- Girl Scouts of America
- Greater Akron Audubon Society
- Hale Farm
- Heritage Farms
- In Defense of Deer
- Kirtland Bird Club
- Luther Farms
- National Parks and Conservation Association
- Ohio & Erie Canal Corridor Coalition
- Ohio Canal Corridor
- Ohio Horseman’s Council
- Ohioans for Animal Rights
- Old Trail School
- Phyllis Wheatley Association
- Porthouse Theater
- Public Employees for Environmental Responsibility
- Robert L. Hunker Historic Preservation Foundation, Inc.
- Safari International
- SHARK–Showing Animals Respect and Kindness
- Sierra Club
- Stan Hywet Hall and Gardens
- Stanford Youth Hostel
- The Humane Society of the United States

- The Inn at Brandywine Falls
- The Nature Conservancy
- Valley Farms
- Valley View Village Church
- Western Cuyahoga Audubon Society
- Western Reserve Land Conservancy
- Western Reserve Land Conservancy–Medina Chapter
- Whitetails Unlimited
- Woodridge School District

5.4 SCIENCE TEAM MEMBERS

Name	Title	Organization–Location
Sarah Bransom	Former NPS Environmental Protection Specialist	NPS–Denver, Colorado
Paul Curtis, PhD	Associate Professor	Cornell University
Ken Ferebee	Natural Resource Management Specialist	NPS–Rock Creek Park
Damon Greer	Assistant District Wildlife Supervisor	Ohio Department of Natural Resources
David Jacob	Environmental Protection Specialist	NPS–Denver, Colorado
Michael Johnson	Chief, Natural Resource Management	MPSSC
Randy Knutson	Wildlife Biologist	NPS–Indiana Dunes National Lakeshore
Beth Kunkel	Biologist / Team Facilitator	URS Corporation
Dana Otto, AICP	Senior Environmental Scientist	Louis Berger Group
Mike Mayer	Former Environmental Protection Specialist	NPS–Denver, Colorado
Lisa Petit, PhD	Chief, Resource Management/Park Lead	NPS–Cuyahoga Valley National Park
Daniel Petit, PhD	Chief, Natural Resources	Cleveland Metroparks
Alejandro Royo, PhD	Research Ecologist	USDA Forest Service, Northeastern Research Station

Name	Title	Organization–Location
Rusty Schmidt	Biologist & Landscape Architect	URS Corporation
Susan Stout, PhD	Research Project Leader	USDA Forest Service, Northeastern Research Station
Michael Tonkovich, PhD	Research Wildlife Biologist	Ohio Department of Natural Resources
H. Brian Underwood, PhD	Wildlife Biologist	USGS Cooperative Park Studies Unit Wildlife Research Center–Syracuse, New York
Jim Voigt	Former Natural Resource Manager	NPS–Catoctin Mountain Park

5.5 LIST OF PREPARERS AND CONSULTANTS

Name	Title	Education/Responsibility	Experience
National Park Service			
Lisa Petit	Chief, Resource Management/Park Lead, Cuyahoga Valley National Park	BS Zoology; MS Biology; PhD Zoology Project lead, responsible for technical content and review	25 years wildlife conservation research; 11 years wildlife management
David Jacob	Environmental Protection Specialist, Project Manager, Environmental Quality Division Natural Resources, Stewardship and Science	BA History; JD Law Project manager—public review draft, responsible for NEPA policy, guidance, and technical review	9 years
Michael Mayer	Former Environmental Protection Specialist, WASO Environmental Quality Division	BS Wildlife and Fisheries Biology; MS Wildlife Conservation; JD Environmental Law Former Project Manager, responsible for NEPA policy, guidance, and technical review of initial drafts	16 years
Madelyn Ruffner	Former Environmental Protection Specialist, WASO Environmental Quality Division	BS Environmental Studies; MPP Public Policy (Environmental) Former Project Manager, responsible for NEPA policy, guidance, and technical review	10 years
Jenny Powers	Wildlife Veterinarian	BS Veterinary Medicine; DMV; PhD Reproductive Physiology Appendices on CWD and reproductive control; input to Chapter 2 reproductive control option; general review of document	13 years as a veterinarian; 12 years working with wildlife

Name	Title	Education/Responsibility	Experience
Louis Berger Group			
Lucy Bambrey	Former Senior Cultural Resources Specialist	MA Anthropology Responsible for initial rural landscapes sections and review	31 years
Megan Blue-Sky	Environmental Scientist	BA Geography Responsible for GIS analysis and mapping; administrative record	3 years in environmental planning
Dara Braitman	Planner	BA Urban Studies; MUP Urban Planning Responsible for public draft socioeconomic sections of Chapters 3 and 4	5 years in planning
Lori (Gutman) Fox	Senior Planner	BA Environmental Policy; MCP Land Use and Environmental Planning Initial internal scoping and public meeting; comment analysis	12 years in NEPA planning, analysis, public involvement
Jeff Gutierrez	Environmental Planner	BA Environmental Studies Documentation of alternatives meeting and public scoping comment analysis; second drafts of human resource topics	5 years in environmental planning
Dana Otto	Senior Manager	BS Biology; MS Environmental Planning Project manager for initial internal scoping; participation in second meeting	18 years in environmental planning and analysis
Lia (Peckman) Jenkins	Biologist and NEPA Specialist	BS Biology Responsible for research, coordination, and preparation of document (public draft)—Chapter 1 and biological sections of Chapters 3 and 4; administrative record	3 years in environmental planning
Nancy Van Dyke	Senior Consultant	BA Biology and Geography; MS Environmental Sciences Responsible for second internal scoping and alternatives meeting; public meetings; public review draft project manager; Chapter 2; technical review of entire document (public draft)	Over 32 years in environmental planning, assessment, and compliance
Landon Vine	Environmental Scientist	BS Environmental Science; MS Environmental Science Responsible for designing flowcharts for Chapter 2; administrative record	5 years in environmental planning; 3 years in forestry/ecology education
URS Corporation (first drafts of document)			
Jim Burns	Senior Environmental Scientist	BS, Biology; MS, Botany First draft of document—biology sections	29 years in ecological/ environmental research and documentation
Cory Grayburn	NEPA/Ecological Services Manager	BS, Environmental Resource management (minor –wildlife science) Former project manager, responsible for preparation and review of first drafts of Chapters 3 and 4 and DEIS document	22 years in NEPA studies and documentation

Name	Title	Education/Responsibility	Experience
Jim Kooser	Senior Ecologist	BS, Zoology, graduate studies in plant community, ecosystem and landscape ecology First drafts of natural resource topics	23 years in ecological research, management and consulting
Beth Kunkel	Wildlife Biologist, URS/Kimley Horn Associates	BS, Wildlife Management Responsible for facilitation of science team meetings and participation in scoping and alternatives meetings; first draft of alternatives chapter (Chapter 2)	18 years
Pam McWharter	NEPA Planner	BS, Microbiology Responsible for response to internal comment for first drafts of Chapters 1 and 2	4 years with NEPA documentation; 16 years as a remediation scientist
Auggie Ruggiero	Ecologist	BS, Zoology Responsible for preparation of first drafts of Chapters 3 and 4	7 years in ecological consulting
Kim Sandoval	Wildlife Biologist	BA, Environmental, Population, and Organism Biology Responsible for coordination and preparation of document (first drafts of Chapters 1 and 2)	9 years of experience as a wildlife biologist
Greg Sorensen	Technical Writer/Editor	BA, International Affairs Responsible for technical edit of first drafts of Chapters 1 and 2	Over 27 years of experience writing and editing plans
Patti Steinholtz	Senior NEPA Planner, Editor/Graphic Illustrator	BA, Communications and English Responsible for research, coordination, and preparation of document (first drafts of Chapters 1 and 2)	5 years with NEPA documentation; 10 years as graphic artist; 6 years as technical writer

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GLOSSARY

action alternative — An alternative that proposes a different management action or actions to address the purpose, need, and objectives of the plan; one that proposes changes to the current management. Alternatives B, C, and D are the action alternatives in this planning process. See also: "No-Action Alternative."

adaptive management — The rigorous application of management, research, and monitoring to gain information and experience necessary to assess and modify management activities. A process that uses feedback from research and the period evaluation of management actions and the conditions they produce to either reinforce the viability of objectives, strategies, and actions prescribed in a plan or to modify strategies and actions in order to more effectively accomplish management objectives.

affected environment — A description of the existing environment that may be affected by the proposed action (40 CFR 1502.15).

blight — Any of numerous plant diseases that result in sudden and conspicuous wilting and dying of affected parts, especially young growing tissues.

bluetongue virus — An insect-transmitted, viral disease of ruminant animals, including white-tailed deer, which causes inflammation, swelling, and hemorrhage of the mucous membranes of the mouth, nose, and tongue.

browse line — A visible delineation at approximately six feet below which most or all vegetation has been uniformly browsed.

carrying capacity — The maximum number of organisms that can be supported in a given area or habitat.

chronic wasting disease (CWD) — A slowly progressive, infectious, self-propagating neurological disease of captive and free-ranging deer, elk, and moose. CWD belongs to the transmissible spongiform encephalopathy (TSE) group of diseases and is characterized by accumulations of abnormal prion proteins in neural and lymphoid tissue.

contragestive — A product that terminates pregnancy.

cultural landscape — A geographic area (including both cultural and natural resources and the wildlife or domestic animals therein) associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values.

cumulative impacts — Those impacts on the environment that result from the incremental effect of the action when added to the past, present, and reasonable foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

deer herd — The group of deer that have common characteristics and interbreed among themselves. For the purposes of this plan, this term is synonymous with deer population.

deer population — See Deer Herd, above.

demographic — Referring to the intrinsic factors that contribute to a population's growth or decline: birth, death, immigration, and emigration. The sex ratio of the breeding population and the age structure (the proportion of the population found in each age class) are also considered demographic factors because they contribute to birth and death rates.

depredation — Damage or loss.

direct reduction — Lethal removal of deer; includes both sharpshooting and capture/euthanasia.

distance sampling — An analytical method to estimate population density that involves an observer traveling along a transect and recording how far away objects of interest are.

endemic — Native to or confined to a particular region.

ecosystem — An ecological system; the interaction of living organisms and the nonliving environment producing an exchange of materials and energy between the living and nonliving.

epizootic hemorrhagic disease (EHD) — An insect-borne viral disease of ruminants that causes widespread hemorrhages in mucous membranes, skin, and visceral organs.

environment — The sum total of all biological, chemical, and physical factors to which organisms are exposed; the surroundings of a plant or animal.

environmental assessment — A concise public document, prepared in compliance with NEPA, that briefly discusses the purposes and need for an action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9).

environmental consequences — Environmental effects of project alternatives, including the proposed action, any adverse environmental effects which cannot be avoided, the relationship between short term uses of the human environment, and any irreversible or irretrievable commitments of resources which would be involved if the proposal should be implemented (40 CFR 1502.16).

environmental impact statement (EIS) — A detailed written statement required by Section 102(2)(C) of NEPA, analyzing the environmental impacts of a proposed action, adverse effects of the project that cannot be avoided, alternative courses of action, short term uses of the environment versus the maintenance and enhancement of long term productivity, and any irreversible and irretrievable commitment of resources (40 CFR 1508.11).

ethnographic resource — Any site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it.

euthanasia — Ending the life of an animal by humane means.

exclosure — A large area enclosed by fencing to keep out deer and allow vegetation to regenerate.

exotic species — Any introduced plant, animal or protist species that is not native to the area and may be considered a nuisance; also called non-native or alien species.

extirpated species — A species that is no longer present in an area where it once lived.

fenced plot — An area enclosed by a fence to keep deer out so vegetation can grow without the influence of deer browsing.

folliculogenesis — the maturation of the ovarian follicle (see below).

follicle — one of the small ovarian sacs containing an immature egg.

follicle stimulating hormone — a hormone synthesized and secreted by the pituitary gland that (in females) stimulates the growth of immature follicles to maturation.

forest regeneration — For the purposes of this plan, the regrowth of forest species and renewal of forest tree cover such that the natural forest sustains itself without human intervention.

fragmentation — The breaking up of large, contiguous blocks of habitat or landscape into small, discontinuous areas that are surrounded by altered or disturbed lands.

genetic variability — The amount of genetic difference among individuals in a population.

habitat — The environment in which a plant or animal lives (includes vegetation, soil, water, and other factors).

hectare — A metric unit of area equal to 2.471 acres.

herbaceous plants — Non-woody plants; includes grasses, wildflowers, and sedges and rushes (grass-like plants).

herbivore — An animal that eats a diet consisting primarily of plant material.

hypothesis — A tentative explanation for an observation or phenomenon that can be tested by further investigation.

immunocontraception — The induction of contraception by injecting an animal with a compound that produces an immune response that precludes pregnancy.

immunocontraceptive — A contraceptive agent that causes an animal to produce antibodies against some protein or peptide involved in reproduction. The antibodies hinder or prevent some aspect of the reproductive process.

infrared — The range of invisible radiation wavelength just longer than the red in the visible spectrum.

irretrievable — A term that applies to the loss of production, harvest, and consumptive or nonconsumptive use of natural resources. For example, recreation experiences are lost irretrievably when an area is closed to human use. The loss is irretrievable, but the action is not irreversible. Reopening the area would allow a resumption of the experience.

irreversible — A term that describes the loss of future options. Applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity that are renewable only over long periods of time.

fragmentation — The breaking up of large, contiguous blocks of habitat or landscape into small, discontinuous areas that are surrounded by altered or disturbed lands.

leuprolide — A reproductive control agent that prevents secondary hormone secretion, which stops the formation of eggs and ovulation. Leuprolide is a GnRH agonist (see Appendix D for additional details).

luteinizing hormone — a hormone which triggers ovulation in females.

monitoring — A process of collecting information to evaluate if an objective and/or anticipated or assumed results of a management plan are being realized (effectiveness monitoring) or if implementation is proceeding as planned (implementation monitoring).

National Environmental Policy Act of 1969 — A law that requires all Federal agencies to examine the environmental impacts of their actions, incorporate environmental information, and utilize public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements and prepare appropriate NEPA documents to facilitate better environmental decision making. NEPA requires Federal agencies to review and comment on Federal agency environmental plans/documents when the agency has jurisdiction by law or special expertise with respect to any environmental impacts involved (42 USC 4321-4327) (40 CFR 1500-1508).

naturally regenerating and sustainable forest — A forest community that has the ability to maintain plant and animal diversity and density by natural (non-human facilitated) tree replacement.

no-action alternative — The alternative in which baseline conditions and trends are projected into the future without any substantive changes in management (40 CFR 1502.14(d)). Alternative A is the no-action alternative in this planning process.

opportunistic surveillance — Taking diagnostic samples for CWD testing from deer found dead or harvested through a management activity within a national park unit.

paired plot — Two plots used for monitoring that include a fenced and an unfenced plot.

palatability — The property of being acceptable to the taste or sufficiently agreeable in flavor to be eaten.

parasitism — A symbiotic relationship in which one species, the parasite, benefits at the expense of the other, the host.

penetrating captive bolt gun — A gun with a steel bolt that is powered by either compressed air or a blank cartridge. When fired, the bolt is driven into the animal's brain and renders it instantly unconscious without causing pain.

population (or species population) — A group of individual plants or animals that have common characteristics and interbreed among themselves and not with other similar groups.

prion — Protinaceous infectious particle; a microscopic particle similar to a virus but lacking nucleic acid, thought to be the infectious agent for certain degenerative diseases of the nervous system such as CWD.

Record of Decision (ROD) — A concise public record of decision prepared by a federal agency, pursuant to NEPA, that contains a statement of the decision, identification of all alternatives, a statement as to whether all practical means to avoid or minimize environmental harm from the alternative selected have been adopted (and if not, why they were not), and a summary of monitoring and enforcement where applicable for any mitigation (40 CFR 1505.2).

recruitment — Number of organisms surviving and being added to a population at a certain point in time.

reproductive control — A method or methods used to limit the numbers of animals in a population by decreasing the reproductive success of the animals, such as contraception or sterilization.

rural landscape — A type of cultural landscape that exhibits the historic activity as well as the cultural and aesthetic values associated with agriculture.

rut — An annually recurring condition or period of sexual excitement and reproductive activity in deer; the breeding season.

sapling — A young tree, generally not over 4 inches in diameter at breast height.

scoping — An early and open process for determining the extent and variety of issues to be addressed and for identifying the significant issues related to a proposed action (40 CFR 1501.7).

seedling — A young plant grown from seed; a young tree before it becomes a sapling.

sex ratio — The proportion of males to females (or vice versa), in a population. A sex ratio of 50:50 would mean an equal number of does and bucks in a deer population.

sharpshooting — The authorized shooting of animals by specially trained professionals using appropriate weapons for means of effective and efficient lethal control.

spotlight survey — A method used to estimate deer numbers in an area by shining spotlights at night and counting the number of deer observed. This technique provides an estimate of deer numbers but not density.

sterilization — a surgical technique leaving a male or female unable to reproduce.

targeted surveillance — Lethal removal of deer that exhibit clinical signs of CWD, such as changes in behavior and body condition, and testing to determine if CWD is present.

transect — A line along which sampling is performed.

Transmissible Spongiform Encephalopathies (TSEs) — A group of diseases characterized by accumulations of abnormal prion proteins in neural and lymphoid tissues, which cause distinctive lesions in the brain and result in death.

turbidity — Visible undissolved solid material suspended in water.

unfenced plot — A specific unfenced area that allows effects on deer browsing to be seen and to be measured.

ungulate — A hoofed, typically herbivorous, animal; includes horses, cows, deer, elk, and bison.

vaccine — A suspension of killed or attenuated microorganisms that, when introduced into the body, stimulates an immune response against that microorganism.

vascular plant — A plant that contains a specialized conducting system consisting of phloem (food-conducting tissue) and xylem (water-conducting tissue). Ferns, trees, and flowering plants are all vascular plants.

viable white-tailed deer population — A population of deer that allows the forest to naturally regenerate, while maintaining a healthy deer population in the park.

woody plants — Plants containing wood fibers, such as trees and shrubs.

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Appendices

APPENDIX A: SPECIAL-STATUS (STATE-LISTED) PLANT AND ANIMAL SPECIES

The following tables present special-status (state-listed) plant and animal species known to occur within Cuyahoga Valley National Park. Included in the tables are notations on federal and state status, habitat type, migratory status (birds only), and palatability (plants only). Some special-status plants and animals would experience only negligible to minor adverse effects, while other species would likely experience moderate to major adverse effects from deer browsing or by deer management actions.

SPECIAL-STATUS PLANT SPECIES CONFIRMED IN CUYAHOGA VALLEY NATIONAL PARK

Scientific Name	Common Name	Federal Status	State Status[a]	Native Habitat	Palatable to deer?[b]
Aralia hispida	Bristly sarsaparilla	—	E	Forest	Unknown
Carex arctata	Drooping wood sedge	—	E	Forest	No (Perdomo, Nitzsche, and Drake 2004)
Desmodium glabellum	Hairy tick-trefoil	—	E	Open forests	Unknown
Eleocharis ovata	Ovate spikerush	—	E	Open, muddy, or moist areas (ODNR 1998)	Unknown
Equisetum variegatum	Variegated scouring-rush	—	E	Wetlands/calcareous seeps	Unknown
Juniperus communis	Ground juniper	—	E	Open fields/pastures/open forests	No (rarely) (Swift and Gross 2008)
Panicum philadelphicum	Philadelphia panic grass	—	E	Dry woods and thickets	Unknown
Poa saltuensis	Pasture blue grass	—	E	Open meadows, pastures	Unknown
Scirpus americanus	Olney's three-square	—	E	Emergent wetlands	Unknown
Silphium laciniatum	Compass-plant	—	E	Open meadows	Unknown
Carex cephaloidea	Thin-leaved sedge	—	T	Moist, mesic woods	No (Perdomo, Nitzsche, and Drake 2004)
Chimaphila umbellata	Pipsissewa	—	T	Sandy, dry woods	Unknown
Chrysogonum virginianum	Golden-knees	—	T	Moist woods	No (Merrifield Garden Center n.d.)
Elymus trachycaulus	Bearded wheat grass	—	T	Fields/open areas	Unknown
Juncus greenei	Greene's rush	—	T	Emergent wetlands	Unknown
Oryzopsis asperifolia	Large-leaved mountain-rice	—	T	Sun or semi shade in well-drained areas	Unknown
Penstemon canescens	Gray beard-tongue	—	T	Fields/open areas	Unknown
Rhododendron maximum	Great laurel	—	T	Mesic woods	Yes (Ohio Landscape Association n.d.)
Solidago squarrosa	Leafy goldenrod	—	T	Fields/open areas	No (Knox County Park District n.d.)
Triglochin maritimum	Common arrow-grass	—	T	Open emergent wetlands	Unknown

Scientific Name	Common Name	Federal Status	State Status[a]	Native Habitat	Palatable to deer?[b]
Acorus americanus	American sweet-flag	—	P	Emergent wetlands	No (Perdomo, Nitzsche, and Drake 2004)
Carex alata	Broad-winged sedge	—	P	Moist meadows/woods	No (Perdomo, Nitzsche, and Drake 2004)
Carex argyrantha	Silvery sedge	—	P	Forest/edges	No (Perdomo, Nitzsche, and Drake 2004)
Carex aurea	Golden-fruited sedge	—	P	Moist woods	No (Perdomo, Nitzsche, and Drake 2004)
Carex bebbii	Bebb's sedge	—	P	Clearings/open forests	No (Perdomo, Nitzsche, and Drake 2004)
Castanea dentata	American chestnut (fruiting)	—	P	Forests	Yes (University of Illinois n.d.)
Corallorhiza maculata	Spotted coral-root	—	P	Rich open forests	Unknown
Cornus rugosa	Round-leaved dogwood	—	P	Mesic woods	Unknown
Corydalis sempervirens	Rock harlequin	—	P	Openings/sandstone outcrops	Yes (NPS n.d)
Gentianopsis crinita	Fringed gentian	—	P	Fields/calcareous seeps/road cuts	Unknown
Lechea intermedia	Round-fruited pinweed	—	P	Dry eroding slopes/forests	Unknown
Poa languida	Weak spear grass	—	P	Dry oak forests	Unknown
Potamogeton natans	Floating pondweed	—	P	Ponds	Unknown
Sagittaria rigida	Deer's-tongue arrowhead	—	P	Ponds/emergent wetlands	Unknown
Shepherdia canadensis	Canadian buffalo-berry	—	P	Full sun/fields/open forests	Unknown
Sphenopholis pensylvanica	Swamp oats	—	P	Wet areas in full sun	Unknown
Spiranthes lucida	Shining ladies'-tresses	—	P	Wet meadows/lake shores/damp forests/pastures	Unknown, but likely – orchids are often palatable
Spiranthes magnicamporum	Great Plains ladies'-tresses	—	P	Dry, grassy fields	Unknown, but likely – orchids are often palatable
Thuja occidentalis	Arbor vitae	—	P	Wood edges/fields	Yes (Ohio Landscape Association n.d.)

Sources: NPS 2009, 2011; habitats—Andreas 1986; McCance and Burns 1984.

[a] State status: E = state endangered, T = state threatened, P = state potentially threatened

[b] Under some conditions, deer may eat "unpalatable" plants. For example, snow cover may prevent deer from finding food and high deer numbers can create competition for available food, which can cause hungry deer to eat whatever plants are available (Hillsborough Township n.d.). For this analysis, it is recognized that there may be damage to plants that are documented as unpalatable, but it is expected that impacts would be lower than for palatable species.

SPECIAL-STATUS ANIMAL SPECIES CONFIRMED IN CUYAHOGA VALLEY NATIONAL PARK

Scientific Name	Common Name	Federal Status	State Status[a]	Native Habitat[b]	Migratory Status
Mammals					
Myotis sodalis	Indiana bat	Endangered	Endangered	Winter – caves and mines; summer – small stream corridors with well developed riparian wood, upland forests (USFWS 2011); roosts under slabs of peeling bark on dead or mature trees	—
Condylura cristata	Star-nosed mole	—	Species of Concern	Semiaquatic – low, wet soils near lakes (ODNR n.d.)	—
Birds					
Botaurus lentiginosus	American bittern	—	Endangered	Aquatic	Migratory
Bublucus ibis	Cattle egret	—	Endangered	Marsh; forages in both terrestrial and aquatic habitats (Cornell Lab of Ornithology n.d.)	Vagrant
Chlidonias niger	Black tern	—	Endangered	Aquatic (Cornell Lab of Ornithology n.d.)	Migratory
Circus cyaneus	Northern harrier	—	Endangered	Aquatic, open	Migratory
Sphyrapicus varius	Yellow-bellied sapsucker	—	Endangered	Forest	Migratory
Vermivora chrysoptera	Golden-winged warbler	—	Endangered	Open	Migratory (rare breeder)
Bartramia longicauda	Upland sandpiper	—	Threatened	Open	Migratory
Catharus guttatus	Hermit thrush	—	Threatened	Forest	Breeder
Empidonax minimus	Least flycatcher	—	Threatened	Forest, open	Breeder
Falco peregrinus	Peregrine falcon	—	Threatened	Open	Breeder
Haliaeetus leucocephalus	Bald eagle	—	Threatened	Aquatic, forest, open	Migratory (rare breeder)
Ixobrychus exilis	Least bittern	—	Threatened	Aquatic	Migratory (rare breeder)
Junco hyemalis	Dark-eyed junco	—	Threatened	Forest, open	Breeder
Nycticorax nycticorax	Black-crowned night heron	—	Threatened	Aquatic	Migratory
Pandion haliaetus	Osprey	—	Threatened	Aquatic, open	Migratory
Accipter striatus	Sharp-shined hawk	—	Species of Concern	Forest, open	Breeder
Ammodramus henslowii	Henslow's sparrow	—	Species of Concern	Open	Breeder
Ardea alba	Great egret	—	Species of Concern	Aquatic	Migratory
Cistothorus palustris	Marsh wren	—	Species of Concern	Aquatic, open	Breeder

Scientific Name	Common Name	Federal Status	State Status[a]	Native Habitat[b]	Migratory Status
Cistothorus platensis	Sedge wren	—	Species of Concern	Aquatic, open	Breeder
Colinus virginianus	Northern bobwhite	—	Species of Concern	Open	Breeder
Coragyps atratus	Black vulture	—	Species of Concern	Forest, open	Vagrant
Dendroica cerulean	Cerulean warbler	—	Species of Concern	Forest	Breeder
Dolichonyx oryzivorus	Bobolink	—	Species of Concern	Open	Breeder
Gallinula chloropus	Common moorhen	—	Species of Concern	Aquatic	Migratory
Porzana carolina	Sora rail	—	Species of Concern	Aquatic	Breeder
Protonotaria citrea	Prothonotary warbler	—	Species of Concern	Aquatic, forest; depends on understory for foraging	Breeder
Rallus limicola	Virginia rail	—	Species of Concern	Aquatic	Breeder
Aegolius acadicus	Northern saw-whet owl	—	Species of Interest	Forest	Migratory
Anas acuta	Northern pintail	—	Species of Interest	Aquatic	Migratory
Anas americana	American wigeon	—	Species of Interest	Aquatic	Migratory
Anas clypeata	Northern shoveler	—	Species of Interest	Aquatic	Migratory
Anas crecca	Green-winged teal	—	Species of Interest	Aquatic	Migratory
Anas strepera	Gadwall	—	Species of Interest	Aquatic	Migratory
Asio flammeus	Short-eared owl	—	Species of Interest	Aquatic, open	Migratory
Asio otus	Long-eared owl	—	Species of Interest	Forest, open	Migratory
Aythya americana	Redhead duck	—	Species of Interest	Aquatic	Migratory
Carpodacus purpureus	Purple finch	—	Species of Interest	Forest, open	Migratory (rare breeder)
Certhia americana	Brown creeper	—	Species of Interest	Forest	Breeder
Dendroica caerulescens	Black-throated blue warbler	—	Species of Interest	Forest	Migratory
Dendroica fusca	Blackburnian warbler	—	Species of Interest	Forest	Migratory
Dendroica magnolia	Magnolia warbler	—	Species of Interest	Forest	Migratory (rare breeder)
Egretta caerulea	Little blue heron	—	Species of Interest	Aquatic	Vagrant
Gallinago delicata	Wilson's snipe	—	Species of Interest	Aquatic, open	Migratory

Scientific Name	Common Name	Federal Status	State Status[a]	Native Habitat[b]	Migratory Status
Oporonis philadelphia	Mourning warbler	—	Species of Interest	Forest, open	Migratory (rare breeder)
Oxyura jamaicensis	Ruddy duck	—	Species of Interest	Aquatic	Migratory
Regulus satrapa	Golden-crowned kinglet	—	Species of Interest	Forest	Migratory (rare breeder)
Seiurus noveboracensis	Northern waterthrush	—	Species of Interest	Aquatic, forest	Migratory
Sitta canadensis	Red-breasted nuthatch	—	Species of Interest	Forest	Migratory (rare breeder)
Spinus pinus	Pine siskin	—	Species of Interest	Forest, open	Migratory
Troglodytes hiemalis	Winter wren	—	Species of Interest	Forest	Migratory (rare breeder)
Wilsonia canadensis	Canada warbler	—	Species of Interest	Forest	Migratory (rare breeder)
Xanthocephalus xanthocephalus	Yellow-headed blackbird	—	Species of Interest	Aquatic, open	Vagrant
Reptiles					
Clemmys guttata	Spotted turtle	—	Threatened	Aquatic; occasionally wanders away from water and lives in wet woods and meadows (ODNR n.d.)	—
Emydoidea blandingii	Blanding's turtle	—	Species of Concern	Aquatic – marshy shorelines, inland streams, wet meadows (ODNR n.d.)	—
Regina septemvittata	Queensnake	—	Species of Concern	Slow moving or shallow rocky creeks and rivers	—
Terrapene carolina	Eastern box turtle	—	Species of Concern	Woodlands (ODNR n.d.)	—

Source: NPS 2009, 2011; Petit, pers. comm., 2011; habitat for birds – NPS 2010b; migratory status – NPS 2010a, 2010b

— = Not applicable

[a] Definitions of state status are defined by the ODNR Division of Wildlife:

Endangered – A native species or subspecies threatened with extirpation from the state. The danger may result from one or more causes, such as habitat loss, pollution, predation, interspecific competition, or disease.

Threatened – A species or subspecies whose survival in Ohio is not in immediate jeopardy, but to which a threat exists. Continued or increased stress will result in its becoming endangered.

Species of Concern – A species or subspecies which might become threatened in Ohio under continued or increased stress. Also, a species or subspecies for which there is some concern, but for which information is insufficient to permit an adequate status evaluation. This category may contain species designated as a furbearer or game species, but whose statewide population is dependent on the quality and/or quantity of habitat and is not adversely impacted by regulated harvest.

Species of Interest – A species that occurs periodically and is capable of breeding in Ohio. It is at the edge of a larger, contiguous range with viable population(s) within the core of its range. These species have no federal endangered or threatened status, are at low breeding densities in the state, and have not been recently released to enhance Ohio's wildlife diversity. With the exception of efforts to conserve occupied areas, minimal management efforts will be directed for these species because they would be unlikely to result in significant increases in their populations within the state.

[b] Native habitat for birds defined: aquatic = river, marsh, swamp, pond; open = fields, thickest, lawns

[c] Only those species with the potential to be affected by deer browsing and/or deer management activities will be carried forward and analyzed in Chapter 4

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Personal Communication

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2011 Personal communication via email with Lia Peckman, The Louis Berger Group, Inc., containing an updated state-listed animal species table, in which the park provided additional data/information. June 28, 2011.

APPENDIX B: DEER AND VEGETATION MONITORING METHODS

This appendix describes the protocols for both deer and vegetation monitoring related to implementation of this plan.

DEER POPULATION MONITORING METHODS

Park staff will continue to use the distance sampling method to annually estimate the deer population density within the park. Distance sampling is a reliable analytical method for estimating population densities (Buckland et al. 2001; Thompson et al. 1998). It is conducted by an observer traveling along a transect and recording how far away deer are. The method models the way a person sees so that a proportion of deer further from the observer are expected to be missed. Unbiased estimates of population density can be obtained from the distance data if three assumptions are met: (1) deer on the line or point are detected with 100 percent certainty, (2) deer are detected at their initial location, and (3) distance measurements are exact (Buckland et al. 2001; Thompson et al. 1998; Underwood et al. 1998).

Surveys are conducted at night during the first two weeks of November. These dates typically coincide with high mobility of deer during the mating season and after most tree leaves have fallen. Thus, detectability of deer is maximized. Surveys begin no earlier than 30 minutes after sunset (actual time sunset). Deer are most active at dusk and early evening. Surveys are postponed if viewing conditions are poor or observer safety is threatened (e.g., due to weather conditions).

Distance sampling surveys are conducted for a minimum of five nights during the 2-week sampling period. Survey transects consist of 32 miles of roads within the park and 8 miles of railroad. The park is arbitrarily subdivided into five sampling zones of similar areal extent and with a similar number of miles of transect length. A minimum sample size of distances to 60 deer groups is obtained within each zone.

A minimum three-person crew, consisting of a driver who serves as data recorder, and two observers, are required to execute each survey. Surveys are conducted from open bed pick-up trucks with an elevated platform with seats placed in the truck bed for observers. Surveys on the railroad are conducted using a hi-rail truck with an open, high-sided bed in which observers stand while conducting the survey. Because of the large number of miles of transect, two survey teams are active within each survey night. Survey routes are driven at a speed of approximately 10 miles per hour (mph). Observers use handheld spotlights to illuminate the survey area on both sides of the transect extending the light out; one person observes each side of the transect. Upon detection of a deer, the observer directs the driver to position the vehicle such that the perpendicular distance (90° angle to the transect) is measured.

In all instances, the distance measured should be to the initial location of the deer prior to any movement. The distance is measured using a laser rangefinder and is measured to an individual deer or, in the case of a group of deer, to the deer closest to the center of a group. In order to detect deer directly on the transect, the driver observes the groups of deer on the transect line and records the distance of the deer or group, if any, from the transect line using the laser range finder.

Deer are categorized by group size (e.g., an individual deer is a group of one, and five deer are a group of five). Deer are partitioned into groups by using behavioral cues and the nearest neighbor criterion (LaGory 1986). For instance, deer that repeatedly look back at other deer are counted as part of a group. Additionally, if an individual deer is less than half the distance from the closest deer than from its next nearest neighbor, then that individual deer is counted as part of a group. When large groups of deer are

seen in open fields, group classification is attempted before positioning the vehicle for a distance measurement, which minimizes a flight response. In cases where the deer run away, the observer will note the initial location of the group and obtain a distance measurement to the location of first detection. Data are recorded on a standard deer Distance Sampling datasheet. Demographic classification is collected only as "antlered" or "no antlers," when possible. "Unknown" is the default classification.

Data is analyzed using the most current version of Distance (which is 6.0 in 2011). Using this software program, models are generated that provide estimates of population density (deer per square mile) with well-defined confidence intervals. The minimum amount of data required includes the survey dates, transect length, number in group, and distance.

VEGETATION MONITORING METHODS

HERBACEOUS PLANT COMMUNITY METRIC

The general protocol to be used for monitoring *Trillium grandiflorum* populations and determining when to take action is outlined below:

- Conduct monitoring during the trillium growing season (April through June).
- Measure the stem height of all mature/reproductive (3-leaved) trillium plants in each open plot. Combine data per plot to determine mean stem height in each plot.
- Use exclosure plot data to determine if differences in stem heights between open and closed plots are measuring impacts from deer browsing, or indicating a difference in maturity of plants. The percentage of reproductive plants within the open plots that are flowering would be used to determine if decreases in mean stem height are due to an increase in the number of shorter non-reproductive plants or due to deer browsing. If the stem height difference between established open and closed plots is not distinguishable, then those open plots would be excluded from the action determination in that year.
- Determine the number of plots with mean stem height less than 5 inches per plot.
- If more than 25 percent of plots per zone have a mean stem height less than 5 inches, a level of concern is reached.
- If more than 50 percent of plots per zone have a mean stem height less than 5 inches, a level of action is reached.

WOODY PLANT COMMUNITY METRIC

The general protocol to be used for monitoring and determining when to take action in woody plant communities is described below:

- Conduct monitoring during early summer (June/July).
- Use measurements from open plots, with measurements from exclosures used as a basis (or control) for comparison with open plot data.
- Use a densiometer to measure the light available at 5 feet above the ground within each plot. Exclude plots that read zero to 5 percent available light in order to control for effects of shading on seedling growth during different forest regeneration periods.

- Measure tallest seedling per plot. Compare tallest seedling height to previous year's plot data to determine positive growth, negative growth, or no change.
  - If a positive change (growth) in tallest stem height is found in the majority (51 percent or more) of plots, then no action is needed.
  - If a negative or no change in tallest stem height is found in more than 50 percent of the plots, action is needed.
  - If a negative or no change in tallest stem height is found in more than 25 percent of plots, level of concern is reached.

APPENDIX C: CHRONIC WASTING DISEASE

This appendix summarizes guidance provided by the National Park Service (NPS) in response to chronic wasting disease (CWD), and it outlines management options available to parks for implementation in the absence of a specific CWD plan.

As of March 2011, CWD has been diagnosed in only two national parks — Rocky Mountain and Wind Cave national parks. However, several national park system units are at high risk because of their proximity to known CWD cases in many areas of the United States. There is a high likelihood that the disease will be detected in other areas of the country following increases in disease surveillance as well as disease spread. CWD presents population decline risks to wild cervids and although there is no evidence to suggest that CWD is transferred to domestic animals or humans these risks are not completely understood. Therefore, CWD has become an issue of national importance to wildlife managers and other interested publics, as well as NPS managers.

NPS POLICY AND GUIDANCE

DIRECTOR'S CWD GUIDANCE MEMORANDUM (JULY 26, 2002)

The NPS director provided guidance to regions and parks on NPS response to CWD in a memorandum dated July 26, 2002. Even though the memo pre-dates current CWD distribution, the guidance remains pertinent. The guidance addresses surveillance, management, and communication regarding the disease. It also strictly limits human assisted translocation of deer and elk into or out of national park system units. Deviation from the guidance memo requires a waiver approved by the director.

A NATIONAL PARK SERVICE MANAGER'S REFERENCE NOTEBOOK TO UNDERSTANDING CHRONIC WASTING DISEASE (VERSION 4: JULY 2007; UPDATED VERSION 5 RELEASED JANUARY 2012)

This notebook serves as an informational reference that summarizes some of the most pertinent CWD literature, management options, and policies as they pertain to units of the national park system. It is not meant to be an all-inclusive review of current literature or management options. CWD is an emerging disease, and the knowledge base is continuing to expand. This document will be updated as necessary to include information pertinent to the NPS.

ELK AND DEER MEAT FROM AREAS AFFECTED BY CHRONIC WASTING DISEASE: A GUIDE TO DONATION FOR HUMAN CONSUMPTION (MAY 2006)

This document provides an overview of the issues surrounding CWD as it relates to public health, and includes NPS recommendations for the use of cervid meat for human consumption from parks affected by CWD surveillance and management actions within or near areas where CWD has been identified or where CWD testing is being conducted.

DESCRIPTION AND DISTRIBUTION

CWD is a slowly progressive, infectious, self propagating, neurological disease of captive and free-ranging mule deer (*Odocoileus hemionus*), white-tailed deer (*O. virginianus*), Rocky Mountain elk (*Cervus elaphus nelsoni*), and moose (*Alces alces*). The disease belongs to the transmissible spongiform encephalopathy (TSE) group of diseases (similar to scrapie and bovine spongiform encephalopathy).

CWD is the only TSE currently found in free-ranging animals. TSEs are characterized by accumulations of abnormal prion (proteinaceous infectious particle) proteins in neural and lymphoid tissues (Prusiner 1982, 1991, 1997).

There is evidence that human-associated movement of cervids has aided in the spread of the disease in captive, and likely free-ranging, deer and elk (Miller and Williams 2003; Salman 2003; Williams and Miller 2003). Localized artificial concentration of cervids in areas with few natural predators likely aids in disease transmission (Spraker et al. 1997; Samuel et al. 2003; Farnsworth et al. 2005, Wild et al. 2011). There is strong evidence to suggest that anthropogenic factors, such as land use, influence CWD prevalence (Farnsworth et al. 2005). Therefore, human influences are likely a significant component of observed CWD distribution and prevalence. CWD is considered a non-native disease process (Wild et al. 2011).

As of March 2011, CWD had been found in captive/farmed cervids in 12 states and 2 Canadian provinces and in free-ranging cervids in 15 states and 2 provinces. The historic area of CWD infection encompasses northeastern Colorado, southeastern Wyoming, and the southwest corner of the Nebraska panhandle (Williams and Miller 2002; Williams et al. 2002). However, with increased surveillance that has occurred since 2001, the disease has been found with increasing frequency in other geographically distinct areas (Joly et al. 2003).

CLINICAL SIGNS

The primary clinical signs of CWD in deer and elk are changes in behavior and body condition (Williams et al. 2002). Signs of the disease are progressive. Initially only someone who is quite familiar with a particular animal or group of animals would notice a change in behavior. As the clinical disease progresses over the course of weeks to months, animals demonstrate increasingly abnormal behavior and additional clinical signs (Williams and Young 1992). Affected animals can lose their fear of humans, show repetitive movements, and/or appear depressed but quickly become alert if startled. Affected animals rapidly lose body condition, despite having an appetite (Williams et al. 2002). In the end stages of the disease they become emaciated. Once an animal demonstrates clinical signs, the disease is invariably fatal. There is no treatment or preventative vaccine for the disease.

DIAGNOSIS AND TESTING

CWD was initially diagnosed in deer and elk by testing a portion of the brain (histopathology techniques) (Williams and Young 1993). While this method is effective at diagnosing relatively advanced cases, it is not sensitive enough to detect early disease stages (Spraker et al. 1997; Peters et al. 2000).

In contrast, immunohistochemistry (IHC) is a sensitive, specific, and reliable test that can be used to identify relatively early stages of chronic wasting disease. This technique can detect CWD prions in many tissues (brain, retropharyngeal lymph nodes, and tonsils) (O'Rourke et al. 1998).

In addition to immunohistochemistry, which takes several days to complete, new rapid tests also employ antibody technology to diagnose CWD. Each has various advantages and disadvantages. Only certified laboratories can perform immunohistochemistry or the rapid CWD tests.

No test available is 100 percent sensitive for CWD, which means that a negative test result is not a guarantee of a disease-free animal.

TRANSMISSION

Like other contagious diseases, CWD transmission increases when animals are highly concentrated. High animal densities and environmental contamination are important factors in transmission among captive cervids. These factors may also play a role in transmission in free-ranging animals (Miller et al. 2004).

Management actions that increase mortality rates in diseased populations can retard disease transmission by

1) Reducing the average lifetime of infected individuals. Reduced lifespan, in turn, can compress the period of time when animals are infectious, thereby reducing the number of infections produced per infected individual.
2) Reducing population density. The effect of reduced intervals of infectivity is amplified by reductions in population density because there are potentially fewer infectious contacts made. Both of these mechanisms may retard the transmission of disease. If these mechanisms cause the number of new infections produced per infected individual to fall below one, then the disease will be eliminated from the population (Tompkins et al. 2002). The likelihood of this occurring is unknown at this time.

DISPOSAL OF CWD INFECTED ORGANIC MATERIAL

Discarding known or suspect CWD-contaminated organic material, such as whole or partial carcasses, is likely to become an important issue for national park system units in the future. Each state, Environmental Protection Agency region, and refuse disposal area is likely to have different regulations and restrictions for disposal of potentially infected tissues. Currently there is no national standard for disposal. Because infected carcasses serve as a source of environmental contamination (Miller et al. 2004), it is recommended that known and suspect CWD-positive animals be removed from the environment.

Given the type of infectious agent (prions), there are limited means of effective disposal. In most cases, however, off-site disposal of infected material is recommended in approved locations. The available options for each park will vary and will depend on the facilities present within a reasonable distance from the park. Disposal of animals that are confirmed to be infected should be disposed of in one of the following ways:

- Alkaline Digestion — Alkaline digestion is a common disposal method used by veterinary diagnostic laboratories. This method uses sodium hydroxide or potassium hydroxide to catalyze the hydrolysis of biological material (protein, nucleic acids, carbohydrates, lipids, etc.) into an aqueous solution consisting of small peptides, amino acids, sugars, and soaps. During this process the prion proteins are destroyed.
- Incineration — Incineration is another disposal method commonly used by veterinary diagnostic laboratories. This method burns the carcass at intense temperatures (600 – 1000 degrees centigrade).
- Landfill — The availability of this option varies by region, state, and local regulations. Therefore, local landfills must be contacted for more information regarding carcass disposal, to determine if they can and will accept CWD positive carcasses or carcass parts.

MANAGEMENT

Chronic wasting disease has occurred in a limited geographic area of northeastern Colorado and southeastern Wyoming for over 30 years. Relatively recently, it has been detected in captive and free-ranging deer and elk in several new locations, including Nebraska, South Dakota, New Mexico, Utah, new areas of Wyoming and Colorado, and east of the Mississippi River in Wisconsin, Illinois, West Virginia, New York, Michigan and most recently in North Dakota, Minnesota, Virginia, and Maryland.

The NPS does not have a single overarching plan to manage chronic wasting disease in all parks. However, it has provided guidance to parks in how to monitor for and minimize the potential spread of the disease, as well as remove infected animals from specific areas. Generally, two levels of action have been identified, based on risk of transmission: (1) when CWD is not known to occur within a 60-mile radius from the park, and (2) when the disease is known to occur within the park or within a 60-mile radius.

The chance of finding CWD in a park is related to two factors: the risk of being exposed to the disease (the likelihood that the disease will be introduced into a given population), and the risk of the disease being amplified once a population of animals has been exposed. The first risk is important for national park system units where no CWD cases have been identified within 60 miles of their border. The second risk applies to units where chronic wasting disease is close to or within their borders, as well as in proactive planning efforts. By evaluating the risk of CWD exposure and amplification, managers can make better decisions regarding how to use their resources to identify the disease.

Actions available to identify CWD are linked to the risk factors present in and around the park. When risk factors are moderate, surveillance for chronic wasting disease can be less intense (e.g., opportunistic) than when risk is high. When the risk is higher, surveillance of all types should be increased. Other management actions that are in place for the host species may limit risk of exposure or transmission by maintaining biologically appropriate population densities. Whether CWD is within 60 miles of a unit or not, coordination with state wildlife and agriculture agencies when conducting CWD surveillance is strongly encouraged.

OPPORTUNISTIC SURVEILLANCE

Opportunistic surveillance involves taking diagnostic samples for testing from deer found dead or harvested through a management activity within a unit of the national park system. Cause of death may be culling, predation, disease, trauma (hit by car), or undetermined. Opportunistic surveillance has little, if any, negative impact on current populations. Unless deer are culled, for either population management or research goals, relatively small sample sizes may be available for opportunistic testing. Animals killed in collisions with vehicles may be a biased sample that could help detect CWD. Research has indicated that CWD-infected mule deer may be more likely to be hit by vehicles than non-CWD infected deer (Krumm et al. 2005).

Opportunistic surveillance is an excellent way to begin surveying for presence of CWD without changing management of the deer population. This is a good option for park units where CWD is a moderate risk but where it has not yet been encountered within 60 miles of the park. Opportunistic surveillance should also be used in parks in close proximity to the disease.

TARGETED SURVEILLANCE

Targeted surveillance entails lethal removal of deer that exhibit clinical signs consistent with CWD. Targeted surveillance has negligible negative effects on the entire population, removes a potential source

of CWD infection, and is an efficient means of detecting new centers of infection (Miller et al. 2000). One limitation to targeted surveillance is that environmental contamination and direct transmission may occur before removal. Targeted surveillance is moderately labor intensive and requires educating park staff in recognition of clinical signs, as well as vigilance for continued observation and identification of potential CWD suspect animals. Training is available through the NPS Biological Research Management Division. Targeted surveillance is recommended in areas with moderate to high CWD risk (within 60 miles of known CWD occurrence) or in park units where CWD has already been identified.

POPULATION REDUCTION

Population reduction involves randomly culling animals within a population in an attempt to reduce animal density, and thus decrease transmission rates. In captive situations, where animal density is high, the prevalence of CWD can be substantially elevated compared to that seen in free-ranging situations. Thus, it is hypothesized that increased animal density and increased animal-to-animal contact, as well as increased environmental contamination, enhance the spread of CWD. Therefore, decreasing animal densities may decrease the transmission and incidence of the disease. However, migration patterns and social behaviors may make this an ineffective management strategy if instead of dispersing across the landscape, deer and elk stay in high-density herds in small home ranges throughout much of the year (Williams et al. 2002). Population reduction is an aggressive and invasive approach to mitigating the CWD threat. It has immediate and potentially long-term effects on local and regional populations of deer and the associated ecosystem. This may be an appropriate response if animals are above population objectives and/or the need to know CWD prevalence with a high degree of accuracy is vital.

COORDINATION

Regardless of which surveillance method is used, each park should cooperate with state wildlife and agriculture agencies in monitoring CWD in park units, working within the park's management policies. CWD is not contained by political boundaries, thus coordination with other management agencies is important.

Additionally, as stated above, the NPS Biological Resource Management Division provides assistance to parks for staff training (e.g., sample collection, recognizing clinical signs of CWD) and testing (e.g., identifying qualified/approved labs or processing samples).

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APPENDIX D: REVIEW OF WHITE-TAILED DEER FERTILITY CONTROL

INTRODUCTION

Managing the overabundance of certain wildlife species has become a topic of public concern (Rutberg et al. 2004). Species such as Canada geese (*Branta canadensis*), coyotes (*Canis latrans*), and white-tailed deer (*Odocoileus virginianus*) have become either locally or regionally overabundant in many areas in the United States (Fagerstone et al. 2002). Traditional wildlife management techniques such as hunting and trapping are often unfeasible, publicly unacceptable, or illegal in many parks, urban, and suburban areas, forcing wildlife managers to seek alternative management methods (Muller, Warren, and Evans 1997). The use of reproductive control as a wildlife management tool has been studied for several decades.

For reproductive control agents to effectively reduce population size, treatment with an agent must decrease the reproductive rate to less than the mortality rate in a closed population with no immigration or emigration. In an open population, where there is much animal movement into and out of an area being considered for treatment, the use of fertility control agents is not likely to be successful in decreasing a population (Rudolph, Porter, and Underwood 2000). Good estimates of population emigration, immigration, and birth and survival rates are needed before predictive models can be used to approximate the effort required to successfully use contraception as a population management technique.

The purpose of this document is to provide NPS managers with (1) a brief overview of contemporary reproductive control options as they pertain to white-tailed deer; (2) an outline of the primary advantages, disadvantages and challenges related to the application of wildlife fertility control agents including population management challenges, regulatory issues, potential logistical issues, and consumption issues; and (3) an evaluation of current fertility control agents against criteria established by the park for use of a reproductive control agent. This document is not intended to be exhaustive but to provide a scientifically sound basis for understanding and evaluating deer management alternatives that include reproductive control of female deer.

It is important to note that some of the most critical elements of a successful population level fertility control program focus on ecological and logistical questions rather than the efficacy of fertility control agents in individual animals. It should also be noted that technology and regulation is changing rapidly in this field and updated information should be reviewed prior to implementation of a deer management program that involves fertility control.

There is general agreement that because of the logistical difficulties of treating significant numbers of deer that controlling large, open, free-ranging populations of wild ungulates solely with a contraceptive vaccine is impractical and unlikely to succeed (Rutberg et al. 2004; Garrott et al. 1992; Garrott 1995; Warren 2000; Rudolph, Porter, and Underwood 2000; Cowan, Pech, and Curtis 2002; Merrill, Cooch, and Curtis 2003 and 2006). There is also agreement that fertility control as a exclusive means of managing populations cannot reduce wildlife population size rapidly (Rutberg and Naugle 2008a, Kirkpatrick and Turner 2008). The few long-term (> 10 year) research projects evaluating population level effects of PZP on long-lived species (horses and deer) support this statement. At Assateague Island National Seashore, PZP treatments were successful in reducing the wild horse population 16 percent (from 160 to 135 individuals) between 1994 and 2009 (15 years). The park expects to reach the target population size of 135 horses in another 8-9 years (C. Zimmerman, pers. comm., 2009). At Fire Island National Seashore, park managers report a 33 percent reduction in overall deer population size (from approximately 600 to 400 individuals) between 1994 and 2009 (M. Bilecki, pers. comm., 2009). In the most intensively treated

areas of the park deer population size decreased up to 55 percent over 15 years (Rutberg and Naugle 2008a). All population level studies have been conducted in relatively closed populations. The appropriateness of fertility control as a deer management tool is heavily dependent on specific park objectives and the purpose and need for management.

CURRENT TECHNOLOGY

The area of wildlife contraception is constantly evolving as new technologies are developed and tested. For the sake of brevity, this appendix will only discuss reproductive control as it applies to female deer. There is a general understanding in white-tailed deer biology that managing the female component of the population is more important than managing the male component. Based on the polygamous breeding behavior of white-tailed deer, treating males with reproductive control would be ineffective when the goal is population management (Warren 2000; Garrott and Siniff 1992).

Regulation of wildlife fertility control agents can be confusing. If a product is intended for use in a food-producing animal, it must be deemed safe for human consumers. Regardless of its use in food animals, a fertility control agent must be considered safe for use in the target species and not present environmental health hazards to non-target species. Until 2006 the Food and Drug Administration (FDA), was the agency responsible for regulation of wildlife contraceptives and their potential for drug residues. Since this time the Environmental Protection Agency (EPA) has assumed responsibility for regulating contraceptives for use in free-ranging wildlife and feral animals (Fagerstone et al. 2010). The EPA, in consultation with the contraceptive manufacturer/sponsor, will determine the safety of the product and marking requirements for free-ranging animals treated with contraceptives. Prior to EPA registration, products can be studied in free-ranging populations to gather safety and efficacy data under an experimental use permit (EUP) which is obtained by the product's sponsor. Until products are registered by the EPA, and marking requirements made explicit, animals treated with any fertility control product should be permanently marked.

Marking is also needed for long-term monitoring of contraceptive efficacy in individual animals, determining which deer have been treated during implementation and for efficient re-treatment, and to monitor population vital rates. Finally, while NPS units have jurisdiction for wildlife management within their borders, parks are strongly encouraged to cooperate and coordinate with state agencies to manage cross boundary wildlife resources whenever possible (43 CFR 24). Therefore, parks should also communicate with appropriate state agencies regarding marking of treated animals in areas where deer may cross park boundaries. The disadvantages of permanent marking are primarily related to the substantial additional labor and costs of the first year's capture and marking of treated animals, sustainability of this effort over the long term, capture associated stress to individual deer (compared to remote delivery), and potential social acceptance concerns. Despite these drawbacks, marking is nearly always warranted when considering a fertility control program.

There are three basic categories of reproductive control technology: (1) immunocontraceptives (vaccines), (2) non-immunological methods (pharmaceuticals), and (3) physical sterilization.

IMMUNOCONTRACEPTIVES

It has been offered that immunocontraceptive vaccines offer significant promise for future wildlife management (Rutberg et al. 2004). Immunocontraception involves injecting an animal with a vaccine that stimulates its immune system to produce antibodies against a protein (antigen) involved in reproduction (Warren 2000). In order to induce sufficient antibody production, an adjuvant is combined with the antigen. An adjuvant is a product that increases the intensity and duration of the immune system's

reaction to the vaccine. There are two primary types of antigens used in reproductive control vaccines in deer: porcine zona pellucida (PZP) and gonadotropin releasing hormone (GnRH).

Neither PZP nor GnRH vaccines are 100 percent effective in preventing pregnancy. Using a two-dose vaccination protocol Curtis et al. (2002) demonstrated approximately 85-90 percent decrease in the number of fawns born per female after vaccination with either GnRH or PZP immunocontraceptive vaccines in white-tailed deer. Likewise, Rutberg and Naugle (2008a) showed a 75 percent decrease in annual fawn production using PZP vaccination in two relatively closed white-tailed deer populations. In a more contemporary version of the GnRH vaccine, Gionfriddo et al. (2009) found 88 percent efficacy the first year and 47 percent efficacy the second year at preventing pregnancy in white-tailed deer after a single vaccination. The GnRH vaccine has not been evaluated at the population level. Efficacy generally decreases as antibody production wanes. Reduced pregnancy rates can usually be expected for 1 to 2 years post-treatment with immunocontraceptive vaccines although there is the potential for longer-term or even permanent sterility (Fraker et al. 2002; Miller et al. 2008; Miller et al. 2009). Duration of infertility is strongly related to the conjugate-antigen design, the adjuvant used, how the vaccine is delivered, and the host's immune system (Miller et al. 2008; Kirkpatrick et al. 2009).

Porcine Zona Pellucida (PZP). The majority of immunocontraceptive research in wildlife has been conducted using PZP vaccines. PZP vaccines stimulate production of antibodies directed towards specific outer surface proteins of domestic pig ova (eggs). Pig ova are sufficiently similar to many other mammals' ova that antibodies produced will cross-react with the vaccinated animal's own ovum. PZP antibodies prevent fertilization, presumably by blocking the sperm attachment sites on the zona which surrounds the ovum. There are currently two PZP vaccine products being developed, one is simply called PZP and the other SpayVac™.

SpayVac™ (ImmunoVaccine Technologies, Halifax) uses a liposome preparation of PZP mixed with an adjuvant to induce antibody production. This vaccine has been evaluated in a variety of species, including captive and to a lesser extent free-ranging white-tailed deer (Brown et al. 1997; Fraker et al. 2002; Locke et al. 2007; Rutberg and Naugle 2009). The other PZP vaccine, often referred to as "native" PZP, does not use liposome technology but does require a potent adjuvant. Native PZP vaccines have been used extensively in captive wildlife species in the course of investigating its effectiveness (Rutberg and Naugle 2008a; Kirkpatrick et al. 1997; Turner, Kirkpatrick, and Liu 1996; Walter et al. 2002a, 2002b).

The native PZP vaccine has also been tested at length in free-ranging white-tailed deer (Rutberg and Naugle 2008a; Naugle et al. 2002; Rudolph, Porter, and Underwood 2000; Rutberg et al. 2004; Walter et al. 2002a, 2002b; Walter, Kilpatrick, and Gregonis 2003). Potential benefits of the native vaccine include the ability to deliver the vaccine remotely, its safety in pregnant deer and non-target species (Barber and Fayrer-Hosken 2000), and the availability of at least some long-term data on population level effects. The currently available PZP vaccine formulation is effective for two years (Turner et al. 2007; Turner et al. 2008; Rutberg and Naugle 2009), though longer multiyear applications are also being studied. The two-year formulation has received only limited testing in free-ranging white-tailed deer.

SpayVac™ provides the same advantages as native PZP but may result in infertility for up to seven years (Miller et al. 2009). Potential advantages of SpayVac™ compared to the native PZP vaccine are (1) a more rapid immune response, (2) higher antibody titers, (3) a higher proportion of antibodies that bind to target sites, and (4) longer duration of efficacy (Fraker and Bechert 2007). Although little long-term data on population level effects exists for SpayVac™, it is assumed they are similar to those for the native PZP formulation.

Challenges to the use of both PZP vaccines include lack of regulatory approval for use in free-ranging wildlife populations, behavioral impacts (continued estrous cycling), frequency of treatment (need for

booster shots), out of season fawning, and possibly changes in body condition. PZP vaccines are not currently registered for use in free-ranging white-tailed deer but may be in the future (see above for regulatory issues).

PZP based vaccines often cause out of season breeding behavior in treated deer because reproductive hormones which are responsible for estrous cycling are not suppressed (Miller et al. 2009; McShea et al. 1997; Fraker et al. 2002; McShea and Rappole 1997). Repeated estrous cycling has the potential to extend the population breeding season and male/female rutting behaviors. Additionally, extended estrous seasons may result in late pregnancies if the vaccine fails (Fraker et al. 2002; McShea et al. 1997). Fawning later in the summer/fall may lead to higher fawn mortality as winter ensues. Any effect that extends the rut also has the potential for secondary effects to both male and female deer. Increased attempts to breed may result in increased deer movements. It has been suggested that this may encourage deer-vehicle collisions. However, the only known research evaluating this specific issue reported that deer treated with PZP were at no greater risk of being involved in a deer-vehicle collision than untreated deer (Rutberg and Naugle 2008b).

Increased activity during rut can be energetically costly for both sexes. While this is likely offset by the lack of pregnancy demands in female deer it may have cumulative effects on energy expenditures in male deer (Walter, Kilpatrick, and Gregonis 2003; McShea et al. 1997). Alternatively, PZP-treated females may experience increased body condition and a longer life span compared to untreated individuals as a result of reduced energetic costs of pregnancy and lactation (Warren 2000; Hone 1992). For example, at Assateague Island National Seashore, the life span of horses treated with PZP has been extended from an average age at death of 20 years to 26-30 years (Kirkpatrick and Turner 2008; C. Zimmerman, pers. comm., 2009). Longer life span may extend the time needed to observe a decline in population size (Kirkpatrick and Turner 2008). Studies in white-tailed deer investigating effects on body condition are equivocal (Walter, Kilpatrick, and Gregonis 2003; McShea et al. 1997). There are no long-term studies investigating potential extended survival in free-ranging wild deer.

Successful field application of a fertility control program requires both an effective agent and a practical delivery system (Cowan, Pech, and Curtis 2002). Although PZP vaccines may be successfully delivered remotely through darting, the native PZP vaccine that has been tested most extensively requires a series of two initial doses followed by periodic boosters in order to maintain infertility. The need for multiple doses leads to significant logistical issues when working with free-ranging white-tailed deer, particularly when the number of deer to be treated is high. New research involving controlled-release native PZP formulations incorporates primer and booster immunizations into one injection and may extend the period of infertility (Turner et al. 2008). Turner et al. (2008) provides an overview of the current status of research related to controlled-release components of native PZP contraceptive vaccines. The new native PZP formulations have not yet been delivered through a dart. SpayVac™ does not require a first year booster and may prove to be easier to implement because follow-up doses would only be required every 3-7 years (Fraker 2009), however, to our knowledge SpayVac™ has not been delivered remotely.

Many studies have modeled and a few field studies have field tested population-level effects of PZP vaccination (Rutberg et al. 2004; Nielsen, Porter, and Underwood 1997; Rudolph, Porter, and Underwood 2000; Rutberg and Naugle 2008a). Research evaluating the effectiveness of PZP in reducing the size of deer populations has focused on moderate to high density deer populations of relatively small size (< 300-500 individuals). Within these populations, long-term (> 10 year) data indicates that population size of may be gradually reduced using PZP treatments (Kirkpatrick and Turner 2008; Rutberg and Naugle 2008a). Rutberg and Naugle (2008a) reported a 27 percent decline in the size of a small, relatively closed, suburban deer population (approximately 250 deer) between 1997 and 2002, as a result of PZP treatments and potentially other stochastic events. However, level of success in reducing population size varies widely. For example, deer density on Fire Island National Seashore was significantly reduced in some

areas but reduced very little in other areas likely due to inability to treat significant numbers of does in certain areas (Rutberg and Naugle 2008a; Underwood 2005). Site specific modeling using accurate population demographic and vital rate data as well as knowledge of local deer behavior, land access availability and likelihood of achieving treatment application goals is needed to determine how fast a population can be reduced and how deep a reduction can be achieved.

Additional information on PZP may be obtained at http://www.aphis.usda.gov/wildlife_damage/nwrc/research/reproductive_control/index.shtml OR http://www.pzpinfo.org.

Gonadotropin Releasing Hormone (GnRH) Vaccines. GnRH is a small neuropeptide (a protein-like molecule made in the brain) that plays a necessary role in reproduction. It is naturally secreted by the hypothalamus (a region of the brain that regulates hormone production), which directs the pituitary gland to release hormones (luteinizing hormone and follicle stimulating hormone) that control the function of reproductive organs (Hazum and Conn 1988). In an attempt to interrupt this process, research has focused on eliminating the ability of GnRH to trigger the release of reproductive hormones. One option is vaccination against GnRH. Antibodies produced in response to vaccination likely attach to GnRH in the hypothalamic region and prevent the hormone from binding to receptors in the pituitary gland, thus suppressing the secretion of reproductive hormones and preventing ovulation.

GnRH vaccines have been investigated in a variety of wild and domestic ungulates (hoofed mammals) (Adams and Adams 1990; Curtis et al. 2002; Miller et al. 2000; Miller, Rhyan, and Drew 2004). One GnRH vaccine that has been developed specifically for wildlife contraception is GonaCon™. GonaCon™ is registered with the EPA as a restricted use pesticide to control white-tailed deer fertility. The label requires marking the treated animal and giving the vaccine by hand-injection to limit the potential for non-target animal and environmental exposure to the vaccine.

Potential benefits of this vaccine include a relatively long-lasting contraceptive effect (1-2 years and potentially longer) and possibly the lack of repeated estrous cycles (Curtis et al. 2002). In free-ranging white-tailed deer, GonaCon™ is estimated to be 88 percent effective in preventing pregnancy during the first year post-treatment, and approximately 47 percent effective in the second year (Gionfriddo et al. 2009), however long-term field efficacy data currently does not exist. Although the label indicates a minimum of 1 year efficacy, the contraceptive effect typically lasts two years and possibly longer in some individuals (Fagerstone et al. 2008). Repeated estrous cycling and other behavioral changes in white-tailed deer have not been consistently documented in association with GnRH vaccines (Curtis et al. 2008). However, Killian et al. (2008) reported that behavioral expressions of estrus were only decreased for 1-2 years post-treatment and increased in subsequent years despite does remaining infertile and Curtis et al. (2002) reported sporadic and delayed estrous cycling with prolonged fawning season in GnRH vaccinated deer as contraceptive effects waned.

GnRH vaccines have many of the same challenges associated with PZP including the need for repeated treatment to maintain infertility, and the need to mark treated animals. Additionally, as with any vaccine which uses the adjuvant AdjuVac™, immune response to the adjuvant may interfere with determination of the animal's Johne's disease status (a gastrointestinal disease of potential regulatory importance for domestic livestock) (Miller et al. 2008). Managers should be aware of this prior to vaccination if neighboring lands have domestic livestock grazing.

Other challenges to use of GonaCon™ include potential health effects on treated deer, lack of information related to effectiveness at the population level in free-ranging deer, and requirement for hand-injection. Killian et al. 2006 concluded that GonaCon™ was safe for deer and that there were no adverse health impacts associated with unintentional repeated vaccination. However, granulomas and injection site

abscesses have been consistently associated with vaccination (Curtis et al. 2008, Gionfriddo et al. 2009). A ganuloma is a localized inflammatory response to the vaccine that occurs at the site of injection and can persist for many years post-treatment. Overall, no debilitating, long-term impacts to health or changes in behavior have been consistently associated with GnRH vaccination in female deer.

Similar site specific modeling and population data are required for evaluating the potential for success in managing a free-ranging deer population with GonaCon™ as was described for PZP immunocontraception.

Additional information may be obtained at:
http://www.aphis.usda.gov/wildlife_damage/nwrc/research/reproductive_control/index.shtml

Non-immunological Reproductive Control Methods

This group of reproductive control agents includes GnRH agonists, GnRH toxins, steroid hormones, and contragestives.

GnRH Agonists. GnRH agonists are highly active analogs of GnRH which are similar in structure and action to the endogenous hormone. These agonists attach to receptors in the pituitary gland. By attaching to the receptors, these agonists reduce the number of binding sites available and thereby temporarily suppress the effect of the GnRH. As a result of this suppression, reproductive hormones are not released (Aspden et al. 1996; D'Occhio, Aspden, and Whyte 1996). Continuous administration of the agonist is necessary to maintain infertility. This can be accomplished with controlled-release formulations or surgically implanted pumps in addition to daily administration.

Not all agonists have the same effects in all species. In fact, some can have an effect that is the opposite of what is intended. The wide variation in response is likely due to a combination of type of agonist, dose, treatment regime, reproductive status, sex, and species (Becker and Katz 1997). Therefore, it is important to fully understand the effects of a product on a given species. Although many GnRH agonists are used in human as well as veterinary medicine only a few have been investigated in wildlife species (Becker and Katz 1997; Vickery 1986). GnRH agonists have been tested primarily in mule deer and elk and been shown to both suppress reproductive hormones and prevent pregnancy (Baker et al. 2005; Baker et al. 2004; Baker et al. 2002; Conner et al. 2007).

- **Leuprolide acetate**. Leuprolide is a GnRH agonist that when administered as a controlled-release formulation, results in 100 percent pregnancy prevention in treated female elk and mule deer (Baker et al. 2002 and 2004; Conner et al. 2007). In addition, the treatment is reversible, and the effects last only for a single breeding season (Baker et al. 2004; Trigg et al. 2001). Advantages of leuprolide acetate are that it is 100 percent effective in preventing pregnancy, is safe for human consumption (Baker et al. 2004), can be delivered remotely (Baker et al. 2005), does not result in physiological side effects, and there are few behavioral effects (Baker et al. 2004). Treatment did not suppress reproductive behavior during the breeding season but also did not prolong behaviors into the non-breeding season.

Leuprolide is FDA-approved for use in humans and has been used experimentally in cervids. It is not currently approved for use as a free-ranging wildlife as a fertility control drug. It is not known if this application will be pursued in the future. The need to deliver leuprolide subcutaneously via hand injection has traditionally been considered a significant barrier to the long-term application of this drug as a wildlife management tool. However, Baker et al. (2005) successfully applied the treatment through dart delivery which may extend the practical application of this contraceptive.

Treatment using leuprolide differs from GnRH vaccines in that it does not require an adjuvant and does not induce an antibody reaction. Therefore, inflammatory responses to adjuvant components and other physiological effects, often observed with immunocontraceptives, have not been observed in association with leuprolide. It does, however, require a slow release implant that remains under the skin or in the muscle. Additionally, leuprolide does not likely pose a threat to the environment or nontarget species because the drug is not absorbed through the oral route of administration (Baker et al. 2004). Marking requirements for animals treated with leuprolide implants are currently unknown because it is not a registered wildlife contraceptive.

One drawback to the use of leuprolide is the need to treat animals within a short timeframe prior to the breeding season (Conner et al. 2007). If a female is not retreated each year, she has the same chances of becoming pregnant as an animal that was never treated. The need to treat a potentially large number of individuals within a short period of time on an annual basis reduces the feasibility of leuprolide as a wildlife management tool, particularly for large, free-ranging, open deer populations.

- **Histrelin acetate**. Histrelin acetate is effective in suppressing a key reproductive hormone in white-tailed deer (Becker and Katz 1995). However, testing was administered using a mini-pump that was surgically implanted under the animal's skin. This is an infeasible route of administration in free-ranging animals. In the future, a delivery system with slow release characteristics may help to make this a more feasible option for free-ranging wildlife. It is likely that histrelin acetate will also suppress ovulation and pregnancy in white-tailed deer, although this remains to be tested.

GnRH Toxins. GnRH toxins consist of a cellular toxin that is combined with a GnRH analog (either agonist or antagoinst). A GnRH analog is a synthetic peptide similar to the body's own gonadotropin-releasing hormone. Using the analog as a carrier, a cellular toxin can be delivered to specific cells in the pituitary which produce reproductive hormones. Internalization of the toxin leads to cell death. When this occurs, the production of reproductive hormones (leuteinizing hormone and follicle stimulating hormone) is affected. This process has been studied in male dogs (Sabeur et al. 2003), domestic sheep (Nett et al. 1999), rats (Kovacs et al. 1997), and female mule deer (Baker et al. 1999) but the technology is still in the developmental stages and not ready for use in free-ranging wildlife.

Steroid Hormones. The field of wildlife contraception began with research examining the manipulation of reproductive steroid hormones (Matschke 1980, 1977a, 1977b). Treatment usually entails the application of synthetic hormones, such as norgestomet, and melangestrol acetate (Jacobsen, Jessup, and Kesler 1995; DeNicola, Kesler, and Swihart 1997a; Fagerstone et al. 2010). Available products are administered via slow release implants or repeated feeding and have demonstrated variable efficacy and duration of infertility. Most products that are available are used in domestic animal or zoological veterinary medicine and have not been used widely in free-ranging wildlife. Issues related to using steroids include difficulties in treating large numbers of animals for extended periods of time, potential reproductive tract pathological side effects experienced by the treated animals, and concerns over the consumption of treated animals by nontarget species and humans. Although many of these hormones are used as growth promotants in domestic food animal production, they are not labeled for use in free-ranging wildlife. Currently, this method of contraception is not being pursued by the wildlife management community.

Contragestives. Contragestives are products that terminate pregnancy. Progesterone is the primary gestational hormone for maintaining pregnancy in mammals. Many contragestives act by preventing progesterone production or blocking its effect, thereby affecting pregnancy. The primary contragestive that has been researched for use in domestic animals and white-tailed deer is an analog of Prostaglandin F2α (PGF2α) (Becker and Katz 1994; DeNicola, Kesler, and Swihart 1997b; Waddell et al. 2001).

Lutalyse® is a commercially available form of PGF2α. Unlike many of the other alternatives, there are no issues related to consumption of the meat when the animal has been treated with this product. Challenges with contragestives include timing of administration, efficacy, potential to rebreed if breeding season is not finished, and the potential for aborted fetuses on the landscape. These limitations make their use in free-ranging populations for fertility control purposes infeasible.

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 and calls into question the long-term sustainability of sterilization as a wildlife management tool, except under very limited circumstances. Only in rare circumstances is physical sterilization reversible.

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

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APPENDIX E: FOREST COMMUNITY TYPE DESCRIPTIONS

(all those included in the NatureServe database as of 11 April 2011)

UPLAND FORESTS

[CEGL005030] *Quercus velutina - Quercus alba / Vaccinium (angustifolium, pallidum) / Carex pensylvanica* Forest

Translated Name: Black Oak - White Oak / (Lowbush Blueberry, Hillside Blueberry) / Pennsylvania Sedge Forest

Common Name: Black Oak - White Oak / Blueberry Forest

This white oak forest was sampled once in the park. The site is an upper flat with well-drained sand soil. The unvegetated surface is dominated by exposed bedrock, leaf litter and bare soil with trace downed wood. Evidence of disturbance includes heavy human use (trails, picnic area), possible mowing, and the presence of exotic species.

The moderate canopy (50% cover), 20-35 m tall, is dominated by *Quercus alba* and *Acer rubrum*; additional species found at low cover include *Betula alleghaniensis* and Tsuga canadensis. Understory layers are very sparse. Trace shrubs include *Amelanchier arborea*, *Cornus florida*, *Sassafras albidum*, and dwarf-shrub *Vaccinium angustifolium*. Herbs are absent.

[CEGL002068] *Quercus alba - Quercus rubra - Carya ovata* Glaciated Forest

Translated Name: White Oak - Northern Red Oak - Shagbark Hickory Glaciated Forest

Common Name: Midwestern White Oak - Red Oak Forest

This oak-hickory forest was sampled at 20 locations in the park. Sites range from gentle to somewhat steep slopes and summits. Soils are moderately well- to well-drained clay loam, loam, silt, silt loam, and silty clay. The unvegetated surface is dominated by leaf litter with some downed wood and occasional bare soil. Evidence of disturbance includes deer browse, erosion, and the presence of trails and exotic species.

The moderate to dense canopy (50-80% cover), 20-35 m tall, is dominated by *Carya ovata, Quercus alba, Quercus rubra*, and *Quercus velutina*; additional common or abundant species can include *Carya laciniosa, Liriodendron tulipifera*, and *Prunus serotina*. The sparse to moderate (10-60%) subcanopy (10-15 m) is dominated by *Acer rubrum, Acer saccharum, Fagus grandifolia*, and *Ostrya virginiana*. The very sparse to moderate (5-50%) tall-shrub (2-5 m) and short-shrub (1-2 m) layers are made up of canopy and subcanopy species; additional shrubs may include *Carpinus caroliniana, Fraxinus americana, Hamamelis virginiana, Lindera benzoin*, and *Viburnum acerifolium*. The herb layer is sparse and dominated by tree seedlings along with such herbs as *Podophyllum peltatum, Arisaema triphyllum, Prenanthes alba, Polygonatum biflorum, Mitchella repens*, and *Polystichum acrostichoides*.

[CEGL002076] *Quercus velutina - Quercus alba - Carya* (*glabra, ovata*) Forest

Translated Name: Black Oak - White Oak - (Pignut Hickory, Shagbark Hickory) Forest

Common Name: Black Oak - White Oak - Hickory Forest

This black oak - shagbark hickory forest was sampled at ten locations in the park. The sites range from gentle to steep slopes with moderately well- to well-drained clay loam, silt and silt loam soils. The

unvegetated surface is dominated by leaf litter with some downed wood and bare soil. Evidence of disturbance includes past logging, deer browse, and the presence of trails and exotic species.

The sparse to dense canopy (40-80% cover), 15-35 m tall, is dominated by *Quercus velutina*; additional species include *Acer saccharum, Carya ovata, Liriodendron tulipifera, Nyssa sylvatica*, and *Quercus rubra*. The sparse to moderate (20-60%) subcanopy (5-15 m) is dominated by *Fagus grandifolia*, as is the sparse (5-40%) tall-shrub (2-5 m) and short-shrub (1-2 m) layers. Additional species in the shrub layers include saplings of canopy species as well as *Amelanchier arborea, Cornus florida, Hamamelis virginiana, Lindera benzoin, Prunus serotina, Sassafras albidum*, and *Viburnum acerifolium*. The herb layer is sparse, contains many tree seedlings and may include *Arisaema triphyllum, Conopholis americana, Mitchella repens, Parthenocissus quinquefolia, Podophyllum peltatum*, and *Polygonatum biflorum*. This community also supports Ohio state-imperiled *Viburnum opulus var. americanum* and state-vulnerable *Castanea dentata* and *Oligoneuron ohioense*.

[CEGL005013] *Fagus grandifolia - Acer saccharum* Glaciated Midwest Forest

Translated Name: American Beech - Sugar Maple Glaciated Midwest Forest

Common Name: Beech - Maple Glaciated Forest

This beech-maple forest was sampled at 18 locations in the park. Sites range from gentle to steep slopes to lower flats and summits on any aspect. Soils are also variable but typically are moderately well- to well-drained silt loam but can also include silty clay, clay loam, loam and silt. The unvegetated surface is dominated by leaf litter, sometimes with substantial downed wood, and may include some large and small rocks and bare soil. Evidence of disturbance includes deer browse, erosion, and the presence of trails and exotic species.

The sparse to dense canopy (40-90% cover), 20-35 m tall, and very sparse to moderate (5-70%) subcanopy (10-15 m) are codominated by *Acer saccharum* and *Fagus grandifolia*; additional common and/or abundant species may include *Acer rubrum, Fraxinus americana, Liriodendron tulipifera, Magnolia acuminata*, and *Tilia americana*. The very sparse to moderate (5-60%) tall-shrub (2-5 m) and short-shrub (1-2 m) layers share the same dominants as the canopy. *Lindera benzoin, Ostrya virginiana*, and *Viburnum acerifolium* are the most common and abundant shrubs. Native herbs include *Allium tricoccum, Arisaema triphyllum, Carex albursina, Caulophyllum thalictroides, Circaea lutetiana, Mitchella repens, Parthenocissus quinquefolia, Podophyllum peltatum, Polygonatum biflorum, Polystichum acrostichoides*, and *Viola canadensis*. In addition, this community supports Ohio state-critically imperiled *Galium labradoricum* and state-imperiled *Ophioglossum engelmannii*.

[CEGL006689] *Populus deltoides* Early-Successional Semi-natural Forest

Translated Name: Eastern Cottonwood Early-Successional Semi-natural Forest

Common Name: --

This eastern cottonwood early-successional semi-natural forest was sampled at two locations in the park. The sites are gently sloping uplands with poorly drained clay loam soils. The unvegetated surface is dominated by leaf litter with some downed wood. Evidence of disturbance includes the presence of numerous exotic species.

The moderate canopy (50-70% cover), 10-20 m tall, is dominated by *Populus deltoides*; *Carya laciniosa* codominates in one stand. Additional tree species found at lower cover include *Fraxinus americana, Salix nigra*, and *Ulmus americana*. Shrubs are sparse. Herbs (70-90%) are a mix of native and exotic species that includes *Agrostis gigantea, Alliaria petiolata, Apocynum cannabinum, Carex cristatella, Cirsium arvense, Juncus* sp., *Cicuta maculata, Scirpus cyperinus*, and *Solidago canadensis*.

[CEGL006684] *Liriodendron tulipifera - Ulmus* spp. - *Prunus serotina* Forest

Translated Name: Tuliptree - Elm species - Black Cherry Forest

Common Name: --

This successional tuliptree - elm - black cherry forest was sampled at four locations in the park. The sites are gentle lowslopes and summits with somewhat poorly drained to well-drained loam, silty clay and silt loam soils. The unvegetated surface is dominated by leaf litter with some downed wood and bare soil. Evidence of disturbance includes deer browse and the presence of trails and exotic species.

The moderate canopy (50-70% cover), 15-20+ m tall, is dominated by *Liriodendron tulipifera* and may contain *Fraxinus americana, Prunus serotina, Prunus virginiana, Ulmus americana*, and/or *Ulmus rubra*, which also make up the sparse to moderate (20-60%) subcanopy (5-15 m). The sparse (5-40%) tall-shrub (2-5 m) and short-shrub (1-2 m) layers include *Crataegus* spp., *Lindera benzoin*, and several exotic species, most notably *Ligustrum sinense* and *Rosa multiflora*. Common and/or abundant species in the herbaceous layer (10-50%) include *Geum canadense, Impatiens capensis, Parthenocissus quinquefolia, Polygonum virginianum, Polystichum acrostichoides, Verbesina alternifolia*, and *Viola canadensis*. In addition, this community supports Ohio state-imperiled *Phaseolus polystachios*.

[CEGL006687] *Acer rubrum - Prunus serotina / Rosa multiflora* Forest

Translated Name: Red Maple - Black Cherry / Multiflora Rose Forest

Common Name: --

This red maple - black cherry forest was sampled at four locations in the park. The sites are gentle to moderate lowslopes and summits with a full spectrum of soil drainages ranging from well-drained silt loam to poorly drained clay loam soils. The unvegetated surface is dominated by leaf litter with some downed wood and occasional bare soil. Evidence of disturbance includes past logging and clearing, deer browse, and the presence of trails and exotic species.

The moderate canopy (40-70% cover), 20-35 m tall, and sparse to moderate (20-70%) subcanopy (10-15 m) are dominated by *Acer rubrum* and/or *Prunus serotina*; additional tree species may include *Aesculus glabra, Asimina triloba, Fraxinus americana, Ostrya virginiana, Sassafras albidum*, and *Ulmus rubra*. Shrub layers are relatively sparse and are mostly made up of canopy tree saplings. Common herbs (30-50%) include *Circaea lutetiana, Geum canadense, Parthenocissus quinquefolia, Podophyllum peltatum*, and *Polystichum acrostichoides*.

[CEGL006693] *Liriodendron tulipifera - Acer rubrum - Populus* spp. Forest

Translated Name: Tuliptree - Red Maple - Cottonwood species Forest

Common Name: --

This successional tuliptree - red maple - cottonwood forest was sampled at 23 locations in the park. The sites range from gentle to somewhat steep slopes and uplands. Soils range from somewhat poorly drained to well-drained and include clay loam, loam, loamy sand, sand, sandy loam, silt, silt loam, and silty clay. The unvegetated surface is dominated by leaf litter with some downed wood and occasional exposed bedrock, large and small rocks, and bare soil. Evidence of disturbance includes deer browse, past logging and clearing, and the presence of trails and exotic species.

Dominants in the moderate to dense canopy (40-90% cover), 20-35 m tall, include *Acer rubrum, Liriodendron tulipifera*, and *Populus grandidentata*. The very sparse to moderate (5-70%) subcanopy (10-15 m) may include canopy species as well as *Acer saccharum, Fagus grandifolia*, and *Prunus serotina*. Additional tree species include *Magnolia acuminata, Quercus rubra, Quercus velutina, Sassafras albidum*, and *Ulmus rubra*. The very sparse to moderate (5-70%) tall-shrub (2-5 m) and short-

shrub (1-2 m) layers share the same dominants as the canopy. Additional common shrubs include *Hamamelis virginiana, Lindera benzoin, Viburnum acerifolium, Viburnum dentatum*, and exotics *Berberis thunbergii, Ligustrum sinense*, and *Rosa multiflora*. The herb layer is sparse when present and often dominated by tree seedlings. The most common and abundant herbs are *Alliaria petiolata* (exotic), *Arisaema triphyllum, Polystichum acrostichoides, Parthenocissus quinquefolia, Prenanthes alba, Potentilla simplex, Circaea lutetiana, Podophyllum peltatum, Onoclea sensibilis*, and *Polygonum virginianum*. In addition, this community supports Ohio state-imperiled *Phaseolus polystachios* and state-vulnerable *Asclepias variegata*.

[CEGL005043] *Tsuga canadensis - Fagus grandifolia - Acer saccharum* / (*Hamamelis virginiana, Kalmia latifolia*) Forest

Translated Name: Eastern Hemlock - American Beech - Sugar Maple / (American Witch-hazel, Mountain Laurel) Forest

Common Name: East-central Hemlock Hardwood Forest

This hemlock-beech forest was sampled at six locations in the park. The sites range from gentle to steep slopes and summits with mostly northern and western aspects. Soils range from somewhat poorly drained loamy sand to moderately well-drained sandy loam to well-drained silty clay and silt loam. The unvegetated surface is dominated by leaf litter with some downed wood, large and small rocks and bare soil. Evidence of disturbance includes the presence of trails.

The moderate to dense canopy (60-90% cover), 20-35 m tall, and/or sparse to moderate (20-50%) subcanopy (10-15 m) are dominated by *Tsuga canadensis* and may include *Acer saccharum, Betula alleghaniensis, Fagus grandifolia, Liriodendron tulipifera*, and/or *Quercus velutina*. The very sparse to moderate (10-60%) tall-shrub (2-5 m) layer is also dominated by *Tsuga canadensis*, and the sparse (5-10%) short-shrub (1-2 m) layer by *Hamamelis virginiana* and *Viburnum acerifolium*. Herbs are sparse but may include *Arisaema triphyllum, Mitchella repens, Parthenocissus quinquefolia*, and *Polystichum acrostichoides*. No exotic species were reported from examples of this community.

WETLAND FORESTS

[CEGL002018] *Populus deltoides - Salix nigra* Forest

Translated Name: Eastern Cottonwood - Black Willow Forest

Common Name: Midwestern Cottonwood - Black Willow Forest

This eastern cottonwood forest was sampled twice in the park. The sites are seasonally flooded lowlands adjacent to streams. The soil is moderately well-drained silt loam at one site, and well-drained sand at the other. The unvegetated surface is dominated by leaf litter with small amounts of downed wood, rocks and bare sand. Evidence of disturbance includes deer browse, flooding, and the presence of exotic species.

The moderate (50-60% cover) canopy, 20-35 m tall, is dominated by *Populus deltoides*; additional species found at lower cover include *Fraxinus americana, Fraxinus pennsylvanica, Juglans nigra*, and *Platanus occidentalis*. The sparse to moderate (30-50%) subcanopy (10-15 m) includes *Carpinus caroliniana, Ulmus americana*, and *Ulmus rubra*. Shrubs are sparse (10-30%) and made up of species from the canopy and subcanopy. Herbs may be dense (up to 70%); common and/or abundant species include *Circaea lutetiana, Geum canadense, Laportea canadensis, Verbesina alternifolia*, and exotics *Lysimachia nummularia* and *Urtica dioica*.

[CEGL006689] *Populus deltoides* Early-Successional Semi-natural Forest

Translated Name: Eastern Cottonwood Early-Successional Semi-natural Forest

Common Name: --

This eastern cottonwood early-successional semi-natural forest was sampled at two locations in the park. The sites are gently sloping uplands with poorly drained clay loam soils. The unvegetated surface is dominated by leaf litter with some downed wood. Evidence of disturbance includes the presence of numerous exotic species.

The moderate canopy (50-70% cover), 10-20 m tall, is dominated by *Populus deltoides*; *Carya laciniosa* codominates in one stand. Additional tree species found at lower cover include *Fraxinus americana, Salix nigra*, and *Ulmus americana*. Shrubs are sparse. Herbs (70-90%) are a mix of native and exotic species that includes *Agrostis gigantea, Alliaria petiolata, Apocynum cannabinum, Carex cristatella, Cirsium arvense, Juncus* sp., *Cicuta maculata, Scirpus cyperinus*, and *Solidago canadensis*.

[CEGL002586] *Acer saccharinum - Ulmus americana* Forest

Translated Name: Silver Maple - American Elm Forest

Common Name: Silver Maple - Elm Forest

This silver maple forest was sampled once in the park. The site is an intermittently flooded flat with poorly drained clay soil. The unvegetated surface is dominated by leaf litter with some downed wood and bare soil. Evidence of disturbance includes trash and the presence of trails and exotic species.

The moderate canopy (60% cover), 15-20 m tall, is dominated by *Acer saccharinum* and *Salix nigra*. The very sparse (10%) subcanopy (5-10 m) contains *Acer negundo*. Shrubs are absent. The herb layer is dominated by exotics *Lysimachia nummularia, Pennisetum glaucum, Sorghum halepense*, and *Urtica dioica*.

[CEGL002014] *Fraxinus pennsylvanica - Ulmus* spp. *- Celtis occidentalis* Forest

Translated Name: Green Ash - Elm species - Common Hackberry Forest

Common Name: Central Green Ash - Elm - Hackberry Forest

This American elm - ash forest was sampled twice in the park. The sites are gentle lowlands with well-drained to somewhat poorly drained silt loam soils. The unvegetated surface is dominated by leaf litter with some downed wood and bare soil. Evidence of disturbance includes the presence of trails and exotic species.

The moderate (50% cover) canopy, 20-35 m tall, and moderate (60%) subcanopy (10-15 m) contain *Ulmus americana, Fraxinus pennsylvanica, Fraxinus americana*, and *Acer rubrum*. The sparse (30%) tall-shrub (2-5 m) and short-shrub (1-2 m) layers include *Fagus grandifolia, Sassafras albidum*, and exotics *Rosa multiflora* and *Lonicera maackii*. Herbs are sparse. However, this community does support Ohio state-imperiled *Phaseolus polystachios*.

[CEGL005037] *Quercus palustris - Quercus bicolor - Acer rubrum* Flatwoods Forest

Translated Name: Pin Oak - Swamp White Oak - Red Maple Flatwoods Forest

Common Name: Northern (Great Lakes) Flatwoods

This pin oak - swamp white oak forest was sampled twice in the park. The sites are a gentle lower slope and lowland flat. The former site has moderately well-drained silt loam soil, while the other is described as having somewhat poorly drained, saturated silty clay soil. The unvegetated surface is dominated by

leaf litter with some downed wood and bare soil. Evidence of disturbance includes deer browse, past clearing, and the presence of trails and exotic species.

The moderately dense canopy (50-70% cover), 20-35 m tall, is dominated by *Quercus palustris* and/or *Quercus bicolor*; additional species found at lower cover may include *Acer rubrum, Prunus serotina*, and *Quercus rubra*. *Ulmus americana* may dominate a sparse (10-40%) subcanopy (10-15 m). The sparse to moderate (20-70%) tall-shrub (2-5 m) and short-shrub (1-2 m) layers can include *Acer rubrum, Carya cordiformis, Cornus amomum, Fraxinus pennsylvanica, Rhamnus cathartica* (exotic), and *Viburnum dentatum*. Herbs are sparse.

[CEGL006688] *Platanus occidentalis - Acer rubrum - Fraxinus americana* Forest

Translated Name: American Sycamore - Red Maple - White Ash Forest

Common Name:

This American sycamore forest was sampled at 11 locations in the park. The sites are gently sloping lowlands and flat basins near streams that may occasionally flood. Soils are somewhat poorly drained to well-drained clay loam, loam, sandy loam, loamy sand, and silt loam. The unvegetated surface is dominated by leaf litter with some downed wood and occasional large and small rocks and bare soil. Evidence of disturbance includes deer browse, altered hydrology, and the presence of trails and exotic species.

The sparse to dense canopy (40-80% cover), 20-35 m tall, is dominated by *Platanus occidentalis*; additional species may include *Juglans nigra, Populus deltoides, Prunus serotina*, and *Ulmus americana*. The sparse to moderate (20-70%) subcanopy (10-15 m) may contain *Acer negundo, Acer rubrum, Acer saccharum, Aesculus glabra, Fagus grandifolia*, and/or *Ulmus americana*. The very sparse to moderate (5-50%) tall-shrub (2-5 m) and short-shrub (1-2 m) layers are made up of canopy and subcanopy species along with *Lindera benzoin*. The herb layer is sparse (up to 40%) to nearly absent; common and/or abundant species include *Alliaria petiolata* (exotic), *Allium tricoccum, Arisaema triphyllum, Circaea lutetiana, Impatiens capensis, Onoclea sensibilis, Parthenocissus quinquefolia, Polygonum virginianum, Toxicodendron radicans*, and *Verbesina alternifolia*. In addition, this community supports Ohio state-critically imperiled *Galium palustre* and state-imperiled *Actaea rubra*.

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historic places, and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

(2013)

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