

## **CHAPTER 4: ENVIRONMENTAL CONSEQUENCES**

This chapter analyzes both beneficial and adverse impacts that would result from implementing any of the alternatives considered in this plan/EIS. This chapter also includes a summary of laws and policies relevant to each impact topic, definitions of impact thresholds (i.e., negligible, minor, moderate, and major), methods used to analyze impacts, and the analysis methods used for determining cumulative impacts. As required by the CEQ regulations implementing NEPA, a summary of the environmental consequences for each alternative is provided in table 6 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.

### **GENERAL METHODOLOGY FOR ESTABLISHING IMPACT THRESHOLDS AND MEASURING EFFECTS BY RESOURCE**

The following elements were used in the general approach for establishing impact thresholds and measuring the 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
- Thresholds 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 the following sections.

#### **GENERAL ANALYSIS METHODS**

The analysis of impacts follows CEQ guidelines (40 CFR 1500–1508) and Director’s Order 12 procedures (NPS 2011) and is based on the underlying goal of developing a comprehensive and systematic framework for managing non-native ungulates that supports long-term ecosystem protection, supports natural ecosystem recovery, provides desirable conditions for active ecosystem restoration, and supports protection and preservation of cultural resources at Hawai‘i Volcanoes. 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.

For each resource topic addressed in this chapter, the applicable analysis methods are discussed, including assumptions and impact intensity thresholds.

#### **ASSUMPTIONS**

Several guiding assumptions were made to provide context for this analysis. These assumptions are described below.

## ANALYSIS PERIOD

Goals, objectives, and specific implementation actions needed to manage non-native ungulates at the park are established for the next 20 years or until there is a change in conditions that warrants an update. Therefore, for the purposes of the analysis, the life of the plan and period used for assessing impacts is up to 20 years.

## GEOGRAPHIC AREA EVALUATED FOR IMPACTS (AREA OF ANALYSIS)

The geographic study area (or area of analysis) for this plan includes Hawai'i Volcanoes National Park in its entirety, and encompasses the Kīlauea, 'Ōla'a, Mauna Loa, and Kahuku areas. The area of analysis may extend beyond the park's boundaries for some cumulative impact assessments. The specific area of analysis for cumulative impacts is described in table 21.

## DURATION AND TYPE OF IMPACTS

The following assumptions are used for all impact topics (the terms "impact" and "effect" are used interchangeably throughout this document):

- *Short-term impacts.* Impacts would be temporary (i.e., this varies depending on the resource but may occur for a matter of minutes and hours up to weeks at a time), without lasting effects. Examples include impacts on vegetation during a field survey associated with non-native ungulate removal efforts.
- *Long-term impacts.* Impacts would be continuous throughout the life of the plan, with potentially permanent effects. Examples include ongoing impacts on park management and operations, or the beneficial effects on vegetation that result when non-native ungulates are removed.

**NOTE:** All impacts to archeological resources are considered long term.

- *Direct impacts.* Impacts would occur as a direct result of non-native ungulate management actions.
- *Indirect impacts.* Impacts would occur from non-native ungulate management actions but would occur later in time or farther in distance from the action.

## FUTURE TRENDS

Visitor use and demand are anticipated to remain relatively steady over the life of the plan. The number of yearly visitors to Hawai'i Volcanoes National Park has been at an average of 1.4 million visitors per year between 1998 and 2007, although there have been increases and decreases from year to year. There is a possibility that the park could acquire additional adjacent lands throughout the life of this plan (20 years), which could affect park visitation, though acquisition of lands has yet to be ascertained. New facilities could be developed in Kahuku to allow for increased visitor access during the planning period. Considering past visitation trends and the potential for new visitor opportunities, it is expected that annual visitation over the life of the plan could increase slightly, with some variation from year to year.

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TABLE 21: CUMULATIVE IMPACT SCENARIO

Impact Topic	Study Area	Temporal Boundaries	Past Actions	Current Actions	Future Actions (20 years)
Vegetation	Park and adjacent lands	1974 through life of the plan (20 years from implementation)	<ul style="list-style-type: none"> <li>• Non-native plant and animal species management inside the park, including park fencing</li> <li>• Non-native plant and animal species management outside the park, including fencing and game management</li> <li>• Rare and sensitive species restoration activities (including establishment of small fence exclosures and implementation of USFWS recovery plans for sensitive species)</li> <li>• Restoration/rehabilitation activities for native plant communities</li> <li>• Fire ecology and management inside and outside the park</li> <li>• Management related to cultural resources, including historic properties</li> <li>• Other park management plans/actions</li> <li>• Research in the park</li> <li>• Other conservation actions/plans outside the park</li> <li>• Development inside the park, including land clearing (logging, ranching, agricultural use), fragmentation, and loss of vegetation</li> <li>• Development outside the park, including land clearing (logging, grazing, ranching, agricultural use), fragmentation, urbanization, and loss of vegetation</li> <li>• Acquisition of new lands (including Kahuku)</li> <li>• Park visitation</li> </ul>	<ul style="list-style-type: none"> <li>• Non-native plant and animal species management inside the park, including park fencing</li> <li>• Non-native plant and animal species management outside the park, including fencing and game management</li> <li>• Rare and sensitive species restoration activities (including establishment of small fence exclosures and implementation of USFWS recovery plans for sensitive species)</li> <li>• Restoration/rehabilitation activities for native plant communities</li> <li>• Fire ecology and management inside and outside the park</li> <li>• Management related to cultural resources, including historic properties</li> <li>• Other park management plans/actions</li> <li>• Other conservation actions/outside the park</li> <li>• Research in the park</li> <li>• Development inside the park</li> <li>• Development outside the park, including land clearing (logging, ranching, agricultural use), fragmentation, urbanization, and loss of vegetation</li> <li>• Park visitation</li> <li>• Development of the GMP</li> <li>• <i>Ala Kahakai National Historic Trail Management Plan</i></li> </ul>	<ul style="list-style-type: none"> <li>• Non-native plant and animal species management inside the park, including park fencing</li> <li>• Non-native plant and animal species management outside the park, including fencing and game management</li> <li>• Rare and sensitive species restoration activities (including establishment of small fence exclosures and implementation of USFWS recovery plans for sensitive species)</li> <li>• Restoration activities for native plant communities</li> <li>• Fire ecology and management inside and outside the park</li> <li>• Management related to cultural resources, including historic properties</li> <li>• Other park management plans/actions</li> <li>• Research in the park</li> <li>• Other conservation actions/outside the park</li> <li>• Development inside the park</li> <li>• Development outside the park, including land clearing (logging, ranching, agricultural use), fragmentation, urbanization, and loss of vegetation</li> <li>• Proposed Mauna Loa trail system (ongoing feasibility study)</li> <li>• Implementation of the <i>Ala Kahakai National Historic Trail Management Plan</i></li> <li>• Acquisition of new lands</li> <li>• Park visitation</li> <li>• Implementation of the GMP</li> </ul>
Native Wildlife and Wildlife Habitat	Park and adjacent lands	1974 through life of the plan (20 years from implementation)	<p>Same as vegetation, plus:</p> <ul style="list-style-type: none"> <li>• Increased overflights inside and outside the park (includes park administrative activities, commercial air tours, administrative activities of outside agencies, and military overflights)</li> </ul>	<p>Same as vegetation, plus:</p> <ul style="list-style-type: none"> <li>• Ongoing overflights inside and outside the park (includes park administrative activities, commercial air tours, administrative activities of outside agencies, and military overflights)</li> <li>• Development of the ATMP</li> </ul>	<p>Same as vegetation, plus:</p> <ul style="list-style-type: none"> <li>• Implementation of the ATMP</li> </ul>
Rare, Unique, Threatened, or Endangered Species	Island of Hawai'i	1974 through life of the plan (20 years from implementation)	Same as native wildlife and wildlife habitat	Same as native wildlife and wildlife habitat	Same as native wildlife and wildlife habitat
Cultural/Historic Resources (archeological resources, cultural landscapes, ethnographic resources)	Park and adjacent lands	1974 through life of the plan (20 years from implementation)	Same as native wildlife and wildlife habitat	Same as native wildlife and wildlife habitat	Same as native wildlife and wildlife habitat
Wilderness	Designated wilderness areas	1974 through life of the plan (20 years from implementation)	<p>Same as native wildlife and wildlife habitat, plus:</p> <ul style="list-style-type: none"> <li>• Research studies and instrumentation in the park</li> </ul>	<p>Same as native wildlife and wildlife habitat, plus:</p> <ul style="list-style-type: none"> <li>• Research studies and instrumentation in the park</li> <li>• Evaluation of new wilderness areas as part of the GMP process</li> </ul>	<p>Same as native wildlife and wildlife habitat, plus:</p> <ul style="list-style-type: none"> <li>• Research studies and instrumentation in the park</li> <li>• Development of a wilderness management plan</li> </ul>
Soils	Park and downstream watershed	1974 through life of the plan (20 years from implementation)	Same as vegetation	Same as vegetation	Same as vegetation

Impact Topic	Study Area	Temporal Boundaries	Past Actions	Current Actions	Future Actions (20 years)
Soundscapes	Legislated boundary of the park	1974 through life of the plan (20 years from implementation)	<ul style="list-style-type: none"> <li>• Park management actions/plans</li> <li>• Increased overflights inside and outside the park</li> <li>• Non-native plant and animal species management inside the park, including park fencing</li> <li>• Rare and sensitive species restoration activities (including establishment of small fence exclosures and implementation of USFWS recovery plans for sensitive species)</li> <li>• Restoration/rehabilitation activities for native plant communities</li> <li>• Fire ecology and management inside the park</li> <li>• Management related to cultural resources, including historic properties</li> <li>• Research in the park</li> <li>• Development inside the park, including land clearing (logging, ranching, agricultural use), fragmentation, and loss of vegetation</li> <li>• Park visitation</li> </ul>	Same as past actions, plus: <ul style="list-style-type: none"> <li>• Development of the GMP, including evaluation of new wilderness areas</li> <li>• Development of the ATMP</li> </ul>	Same as current actions, plus: <ul style="list-style-type: none"> <li>• Implementation of ATMP</li> <li>• Implementation of GMP</li> <li>• Development of a wilderness management plan</li> </ul>
Land Management Adjacent to the Park	Park and adjacent communities	1974 through life of the plan (20 years from implementation)	<ul style="list-style-type: none"> <li>• Non-native plant and animal species management inside the park, including park fencing</li> <li>• Non-native plant and animal species management outside the park, including fencing and game management</li> <li>• Fire ecology and management inside and outside the park</li> <li>• Other conservation actions/plans outside the park</li> <li>• Development outside the park, including land clearing (logging, ranching, agricultural use), fragmentation, urbanization, and loss of vegetation</li> <li>• Acquisition of new lands (including Kahuku)</li> </ul>	<ul style="list-style-type: none"> <li>• Non-native plant and animal species management inside the park, including park fencing</li> <li>• Non-native plant and animal species management outside the park, including fencing and game management</li> <li>• Fire ecology and management inside and outside the park</li> <li>• Other conservation actions outside the park</li> <li>• Development outside the park, including land clearing (logging, ranching, agricultural use), fragmentation, urbanization, and loss of vegetation</li> <li>• <i>Ala Kahakai National Historic Trail Management Plan</i></li> </ul>	<ul style="list-style-type: none"> <li>• Non-native plant and animal species management inside the park, including park fencing</li> <li>• Non-native plant and animal species management outside the park, including fencing and game management</li> <li>• Fire ecology and management inside and outside the park</li> <li>• Other conservation actions/ outside the park</li> <li>• Development outside the park, including land clearing (logging, ranching, agricultural use), fragmentation, urbanization, and loss of vegetation</li> <li>• Proposed Mauna Loa trail system (ongoing feasibility study)</li> <li>• Implementation of the <i>Ala Kahakai National Historic Trail Management Plan</i></li> <li>• Acquisition of new lands</li> </ul>

Impact Topic	Study Area	Temporal Boundaries	Past Actions	Current Actions	Future Actions (20 years)
Socioeconomics	Park and adjacent communities	1974 through life of the plan (20 years from implementation)	<ul style="list-style-type: none"> <li>• Development outside the park, including land clearing (logging, ranching, agricultural use), fragmentation, urbanization, and loss of vegetation</li> <li>• Development inside the park, including land clearing (logging, ranching, agricultural use), fragmentation, and loss of vegetation</li> <li>• Non-native plant and animal species management inside the park, including park fencing</li> <li>• Non-native plant and animal species management outside the park, including fencing and game management</li> <li>• Rare and sensitive species restoration activities (including establishment of small fence enclosures and implementation of USFWS recovery plans for sensitive species)</li> <li>• Restoration/rehabilitation activities for native plant communities</li> <li>• Fire ecology and management inside and outside the park</li> <li>• Acquisition of new lands (including Kahuku)</li> <li>• Investment in the local economy from the purchase of materials and equipment and providing employment opportunities on the island</li> <li>• Park visitation</li> </ul>	<p>Same as past actions, plus:</p> <ul style="list-style-type: none"> <li>• Development of the GMP</li> <li>• Development of the ATMP</li> <li>• <i>Ala Kahakai National Historic Trail Management Plan</i></li> </ul>	<p>Same as current actions, plus:</p> <ul style="list-style-type: none"> <li>• Implementation of the ATMP</li> <li>• Implementation of the GMP</li> <li>• Proposed Mauna Loa trail system (ongoing feasibility study)</li> <li>• Implementation of the <i>Ala Kahakai National Historic Trail Management Plan</i></li> </ul>
Visitor Use and Experience	Legislated boundary of the park	1974 through life of the plan (20 years from implementation)	<ul style="list-style-type: none"> <li>• Park education and stewardship programs; ranger-led interpretation activities</li> <li>• Increased overflights inside and outside the park</li> <li>• Closures due to volcanic activity</li> <li>• Non-native plant and animal species management inside the park, including park fencing</li> <li>• Rare and sensitive species restoration activities (including establishment of small fence enclosures and implementation of USFWS recovery plans for sensitive species)</li> <li>• Restoration/rehabilitation activities for native plant communities</li> <li>• Fire ecology and management inside the park</li> <li>• Management related to cultural resources, including historic properties</li> <li>• Other park management plans/actions</li> <li>• Research in the Park</li> <li>• Development inside the park, including land clearing (logging, ranching, agricultural use), fragmentation, and loss of vegetation</li> <li>• Acquisition of new lands (including Kahuku)</li> <li>• Park visitation</li> </ul>	<p>Same as past actions, plus:</p> <ul style="list-style-type: none"> <li>• Development of the GMP, including evaluation of new wilderness areas</li> <li>• Development of the ATMP</li> <li>• <i>Ala Kahakai National Historic Trail Management Plan</i></li> </ul>	<p>Same as current actions, plus:</p> <ul style="list-style-type: none"> <li>• Implementation of the GMP</li> <li>• Implementation of the ATMP</li> <li>• Proposed Mauna Loa trail system (ongoing feasibility study)</li> <li>• Implementation of the <i>Ala Kahakai National Historic Trail Management Plan</i></li> <li>• Development of a wilderness management plan</li> </ul>

Impact Topic	Study Area	Temporal Boundaries	Past Actions	Current Actions	Future Actions (20 years)
Visitor and Employee Safety	Park boundary and adjacent lands	1974 through life of the plan (20 years from implementation)	<ul style="list-style-type: none"> <li>• Acquisition of new lands (including Kahuku)</li> <li>• Use of community volunteers and Volunteers in Park (VIP) program for management actions</li> <li>• Non-native plant and animal species management inside the park, including park fencing</li> <li>• Fire ecology and management inside and outside the park</li> <li>• Development inside the park, including land clearing (logging, ranching, agricultural use), fragmentation, and loss of vegetation</li> <li>• Management related to cultural resources, including historic properties</li> <li>• Other park management plans/actions</li> <li>• Park visitation</li> <li>• Increased overflights inside and outside the park (includes park administrative activities, commercial air tours, administrative activities of outside agencies, and military overflights)</li> </ul>	<p>Same as past actions, plus:</p> <ul style="list-style-type: none"> <li>• Development of the GMP</li> <li>• Development of the ATMP</li> <li>• <i>Ala Kahakai National Historic Trail Management Plan</i></li> </ul>	<p>Same as current actions, plus:</p> <ul style="list-style-type: none"> <li>• Implementation of the GMP</li> <li>• Implementation of the ATMP</li> <li>• Proposed Mauna Loa trail system (ongoing feasibility study)</li> <li>• Implementation of the <i>Ala Kahakai National Historic Trail Management Plan</i></li> </ul>
Park Management and Operations	Park and adjacent lands	1974 through life of the plan (20 years from implementation)	<ul style="list-style-type: none"> <li>• Acquisition of new lands (including Kahuku)</li> <li>• Development inside the park, including land clearing (logging, ranching, agricultural use), fragmentation, and loss of vegetation</li> <li>• Development outside the park, including land clearing (logging, ranching, agricultural use), fragmentation, urbanization, and loss of vegetation</li> <li>• Fire ecology and management inside and outside the park</li> <li>• Increased overflights inside and outside the park</li> <li>• Park visitation</li> <li>• Closures due to volcanic activity</li> <li>• Employment opportunities for local community from implementing park management actions</li> <li>• Other park management plans/actions including the use of volunteers in park programs</li> <li>• Research in the park</li> <li>• Non-native plant and animal species management inside the park, including park fencing</li> <li>• Rare and sensitive species restoration activities (including establishment of small fence exclosures and implementation of USFWS recovery plans for sensitive species)</li> <li>• Restoration/rehabilitation activities for native plant communities</li> <li>• Fire ecology and management inside and outside the park</li> <li>• Management related to cultural resources, including historic properties</li> <li>• Other park management plans/actions</li> </ul>	<p>Same as past, plus:</p> <ul style="list-style-type: none"> <li>• Development of the GMP, including evaluation of new wilderness areas</li> <li>• Development of the ATMP</li> <li>• Evaluation of new wilderness areas in Kahuku unit</li> <li>• <i>Ala Kahakai National Historic Trail Management Plan</i></li> </ul> <p>And except:</p> <ul style="list-style-type: none"> <li>• Acquisition of new lands</li> </ul>	<p>Same as current, plus:</p> <ul style="list-style-type: none"> <li>• Implementation of the GMP</li> <li>• Implementation of the ATMP</li> <li>• Proposed Mauna Loa trail system (ongoing feasibility study)</li> <li>• Implementation of the <i>Ala Kahakai National Historic Trail Management Plan</i></li> <li>• Acquisition of new lands</li> <li>• Development of a wilderness management plan</li> </ul>

## INTENSITY OF IMPACTS

For all adverse impacts, the intensity of the impact is described as negligible, minor, moderate, or major. For each impact topic, a distinct set of impact thresholds is used to provide definition of what constitutes an impact of a given intensity. The impact thresholds are aligned to relevant standards based on regulations, scientific literature and research, or best professional judgment. The intensity of an impact on a given topic is determined by comparing the effect to the impact threshold definitions for that topic. Impact thresholds apply to adverse impacts only; beneficial impacts are described, but not assigned an intensity level.

## CUMULATIVE IMPACTS ANALYSIS METHOD

The CEQ regulations for implementing 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, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions” (40 CFR 1508.7). As stated in the CEQ handbook, *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ 1997), 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 (no action).

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*Cumulative impacts are defined as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions” (40 CFR 1508.7).*

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Cumulative impacts were determined by combining the impacts of the alternative being considered with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects and plans at the park and, if applicable, the surrounding area. Table 21 summarizes the actions that could affect the various resources at the park, along with the plans and policies of both the park and surrounding jurisdictions, which were discussed in chapter 1. Additional explanation for most of these actions is provided in the “Cumulative Impacts Scenario” section in this chapter.

The analysis of cumulative impacts was accomplished using four steps:

- **Step 1.** Identify resources affected.  
Fully identify resources affected by any of the alternatives. These include the resources addressed as impact topics in chapters 3 and 4 of this document.
- **Step 2.** Set boundaries.  
Identify an appropriate spatial and temporal boundary for each resource. The temporal and spatial boundary for each resource topic is listed under each topic in table 21.
- **Step 3.** Identify cumulative action scenario.  
Determine which past, present, and reasonably foreseeable future actions to include with each resource. These are listed in table 21 and described below.
- **Step 4.** Perform cumulative impact analysis.

Summarize impacts of these other actions plus impacts of the proposed action to arrive at the total cumulative impact. This analysis is included for each resource in chapter 4.

## CUMULATIVE IMPACTS SCENARIO

### PAST, CURRENT, AND FUTURE ACTIONS IN AND AROUND HAWAI‘I VOLCANOES

Depending on funding and staffing levels, many of the past and current park activities described below would be expected to continue in the foreseeable future. Environmental alterations due to climate change (see discussions in chapter 3) may increase the urgency for some of these activities.

#### Non-native Plant and Animal Species Management Inside the Park, Including Park Fencing

The NPS has been controlling non-native ungulates living inside the park. These efforts are described in detail in chapter 1. As part of these efforts, the NPS has been building and maintaining barrier fences to exclude non-native ungulates. These fencing efforts are also discussed in chapter 1 and as an element common to all alternatives in chapter 2. Since 2003, the NPS has been constructing boundary fences and conducting animal control using a combination of NPS staff and volunteers at Kahuku. Also, vegetation monitoring to evaluate the impact of ungulate removal actions (Katahira 1980; Loh and Tunison 1999; Loh et al. 2005; Tunison et al. 1994; Tunison et al. 1995) has been implemented in various areas of the park. These studies typically have shown an increase of native plant species, while non-native plant abundance may remain the same, increase, or decrease following removal of animals.

In addition to non-native ungulates, the park is also home to other non-native wildlife mammals such as rats, mongoose, and feral cats. In order to protect against predation, removal of small non-native mammals has been conducted around sensitive wildlife species. Trapping and baiting have been used in the vicinity of nesting sites during the breeding season. Other efforts to control non-native animal species have included the use of exclosures to protect vulnerable nēnē from small-mammals. Also, efforts have been made by researchers and park staff to monitor and limit the spread of several disruptive non-native insects and coqui frogs. These include Argentine ants (*Linepithema humile*) and western yellow jacket wasps (*Vespula pensylvanica*). These insects pose a major threat to the health of Hawaiian arthropod communities because they are predators capable of forming large populations in social colonies. In addition to conservation threats, yellow jackets directly impact human welfare and the economy. The NPS is supporting research on impacts caused by these insects and development of control methods (Gruner and Foote 2000; Peck et al. 2008).

Park staff has been monitoring and managing disruptive non-native (invasive) plants found in the park (NPS 1999a). Since the 1980s, strategies for invasive plant control implemented at the park have included (1) minimizing disturbances to the native vegetation such as those caused by non-native ungulates and wildfires, which facilitate the spread of invasive plants; (2) monitoring and mapping the distribution of invasive plants; (3) controlling small or localized infestations parkwide; (4) focusing control of widespread weeds in high priority management units called SEAs; (5) working with other agencies and groups in non-native plant management including development of treatment methods and biological control for some widespread weeds; (6) supporting research on the ecology, seed biology, and phenology of disruptive non-native plant pest species; and (7) educating the public in disruptive non-native plant impacts and the importance of non-native plant control (Tunison 1991).

Approximately 60 invasive plant species have been targeted for management using one or more of the above strategies. Many of these species have limited distributions or may have only recently established in the park. The strategy of removing small, locally distributed populations of non-native plants before they become widespread minimizes damage to native communities and prevents the need for more costly

control in the future. Such early detection and control measures have been primarily focused along roads, trails, other corridors, and recently disturbed areas where many weeds first establish (NPS 2008a). Additional aerial and ground searches have been conducted to find more remote populations. The most disruptive weeds that are too widespread to be controlled throughout the park have been managed in SEAs. These high-priority areas were selected based on (1) the biological community's representativeness of a particular ecological zone and/or its rarity in the park or on the islands; (2) manageability and intactness, so that areas are accessible and the potential for native species recovery is high; (3) the units' concentrations of species diversity and rare species; and (4) the biological community's value for research and interpretation to the public (Kueffer and Loope 2009; Loh and Tunison 2009; NPS 2008a; Tunison and Stone 1992). Inside each SEA, periodic searches have been conducted by ground crews or by aerial surveys and target weeds removed from the area. Methods have varied from manual uprooting to chemically treating individuals. In 2007, there were 27 SEAs covering approximately 66,000 acres.

Fountain grass is a fire-promoting invasive grass that has invaded portions of Kona and South Kohala on the Island of Hawai'i and established in the park. Although initially widespread, over the last 15 years, systematic search (helicopter and ground sweeps) and removal efforts for fountain grass have prevented the buildup of dense populations in the park. In the new Kahuku addition, fountain grass is beginning to invade young lava flows. Park staff have been removing all individuals found in the park, and since 2004 been working with the adjacent Ocean View subdivision community to remove plants along roadsides of the subdivision.

### **Non-native Plant and Animal Species Management Outside the Park, Including Fencing and Game Management**

Non-native ungulate management in the vicinity of the park has included fencing and control of ungulates on portions of the State Natural Area Reserves (Pu'u Maka'ala, Kīpāhoehoe, Manukā); in adjacent Keauhou Ranch, owned by Kamehameha Schools; and in nearby Kaiholena and Kona Hema Reserve, owned by TNC (see the "Land Management Adjacent to the Park" section of chapter 3). The USFWS developed an environmental assessment to evaluate the potential environmental effects of building about 88,500 feet (27,000 meters) of fencing enclosing approximately 2,145 hectares (5,300 acres) of land in the Kona Forest Unit of the Hakalau Forest National Wildlife Refuge. The fencing project, which is intended to keep non-native ungulates and other animals out of the area, began in 2011 and is anticipated to be completed in 2012. The native forests of the Kona Forest Unit support four species of endangered forest birds, the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), and a high diversity of native plant species, several of which are threatened or endangered. Until 2002, the Kona Forest Unit supported the last remaining 'alalā (Hawaiian crows) in the wild, and the area has been identified as a possible place for their reintroduction (USFWS 2007).

The State of Hawai'i Division of Fish and Wildlife has been managing all hunting opportunities and management areas in Hawai'i. Management actions related to hunting outside the park are provided in the "Land Management Adjacent to the Park" section of chapter 3, specifically under the section on Hawai'i.

Since 2007, Hawai'i County has been sponsoring a pilot feral pig management program. The program has been overseen by the USDA Animal and Plant Health Inspection's Wildlife Services and assists residents in getting rid of feral pigs that cause destruction on their properties. An *Environmental Assessment of Feral Swine Damage Management in Hawai'i County* was completed in 2008 (USDA-APHIS 2008).

Non-native plant control outside the park have included efforts to eradicate or contain the spread of incipient weeds on adjacent State Natural Area Reserves (Pu'u Maka'ala, Manukā, and Kīpāhoehoe) on Keauhou Ranch (Kamehameha Schools), and on TNC Lands. Much of the detection and control work has been coordinated by the TMA, of which each land agency is a participating member. TMA recently

completed a weed management plan that prioritized management of target plants in different portions of the TMA (TMA 2009). Island-wide outreach, education, and search and control work to address incipient weeds has been conducted by the Big Island Invasive Species Council, a voluntary partnership of private citizens, community organizations, businesses, landowners, and government agencies to address invasive species issues on the Island of Hawai‘i (BIISC 2010). Beginning in 2004, park staff have been working with the adjacent Ocean View subdivision to control invasive fountain grass on roadsides in the subdivision.

The State of Hawai‘i Department of Agriculture also has assisted communities outside the park addressing other invasive species issues (e.g., coqui frog, little fire ant, nettle caterpillar, and erythrina gall wasp) (HDOA 2010). The primary mission of the State of Hawai‘i Department of Agriculture Plant Pest Control Branch has been to provide a favorable environment for agricultural development in Hawai‘i by limiting plant pest populations that have the potential to cause significant economic damage. This has been achieved through statewide programs using chemical, mechanical, biological, and integrated control measures to eradicate or control plant pests, including insects and mites, mollusks, weeds, and plant pathogens. Pest advisories have kept the public abreast of new threats to the Hawaiian environment (HDOA 2010).

Many of the activities described above would be expected to continue in the foreseeable future. Environmental alterations due to climate change (see discussions in chapter 3) may increase the urgency for some conservation activities.

### **Rare and Sensitive Species Restoration Activities**

Within the park, recovery efforts have been focused on four “flagship” federally endangered species, the nēnē, the hawksbill turtle, the Hawaiian petrel, and the Mauna Loa silversword. These are charismatic species, which help build support for park habitat restoration and rare species recovery programs. Additional efforts have been focused on propagating and planting federally listed and rare plant species into areas protected from damage caused by non-native ungulates

Although relatively small, the park population of endangered nēnē has been increasing due to successful breeding seasons as a result of habitat management. Several small fenced exclosures and a breeding pen have been constructed that protect nēnē from predation by non-native predators. A 10-acre predator-proof pen, to accommodate injured birds, was recently constructed in 2011. Localized trapping has been done during breeding season to protect nests and goslings in unprotected areas of the park. These management actions have been primarily focused in the Kīlauea and Mauna Loa regions of the park. In Kahuku, researchers have been monitoring nēnē with satellite transmitters to better understand their movement and use of the area.

The hawksbill sea turtle, or honu‘ea, is known to nest at three beaches (‘Āpua Point, Halapē, and Keauhou) in the park and at several beaches along the Ka‘ū coastline outside the park. The NPS has been partnering with other federal and state agencies and private landowners to monitor and protect turtles and nests along the remote Ka‘ū coastline. Hawksbill sea turtle restoration involves searching for and protecting nests, removing trash and non-native vegetation, educating visitors, and, when needed, assisting hatchlings to the ocean. Since the project began in 1989, personnel have tagged 89 nesting turtles and protected 677 nests (NPS 2008a).

Park scientists have mapped and studied many of the Hawaiian petrel nesting sites on Mauna Loa within the park (Pratt et al. 2011). Hawaiian petrel restoration has relied on monitoring and protecting nests from small predators at three main breeding colonies in the Mauna Loa Unit. In Kahuku, a small number of

nests were discovered during initial inventories conducted in 2006 but no subsequent monitoring has been done.

The park's Kahuku population of Mauna Loa silversword represents the westernmost extent and the largest of the three populations remaining in the world. This population has persisted in a 2-acre fenced enclosure, protected from mouflon and other non-native ungulates, since the 1970s. In 2005, a small 1/2-acre enclosure was constructed near the natural population, and between 2005 and 2009, three additional enclosures (2 to 25 acres in size) were constructed to accommodate approximately 10,000 plantings. In the Mauna Loa Unit, approximately 11,000 individuals were propagated and planted between 2000 and 2006 inside large fence units.

Additional efforts to propagate and plant rare and endangered plants have been conducted intermittently since the 1920s. The current program, which began in 1997, has focused on reestablishment of species in ungulate-control units. Recovery actions for these sensitive plant species are described in the "Rare, Unique, Threatened, or Endangered Species" section of chapter 3 and include monitoring of natural populations. In Kahuku, where large numbers of ungulates remain on the landscape, there are a total of 12 small fenced enclosures established in several areas. These enclosures vary in size from approximately 1 hectare to approximately 50 hectares. The enclosures serve as a temporary measure to protect individual plants or populations of highly vulnerable listed species from damage by ungulates; and assist park staff in evaluating recovery of native plant communities and species following animal exclusion.

### **Restoration/Rehabilitation Activities for Native Plant Communities**

The overriding goal of the Natural Resource Program has been the restoration of native ecosystems and the recovery of biological diversity (NPS 2008a). The primary strategy for accomplishing these goals has been the control of invasive species described above. However, in areas highly modified by invasive species, reintroduction of native plant species has been undertaken to restore community structure. Since the early 1990s, several projects have been initiated to develop and refine techniques to restore plant biological diversity and community structure in areas where invasive species have been managed. These projects have included evaluating methods for reintroducing fire-tolerant native species in dry 'ōhi'a woodland (Loh et al. 2007; Loh et al. 2009; McDaniel et al. 2008; Tunison et al. 2001), koa forest restoration of former pastures in both the Mauna Loa and Kahuku units of the park (McDaniel et al. 2011), and examining fire use to restore pili grasslands (Tunison et al. 2001). In 2009, a 140 ac prescribe fire was implemented that looked at the response of a pili grassland to fire. Preliminary results from this burn along with several others conducted over the years in the coastal lowland, identified prescribe fire as a potential tool to remove non-native shrubs and trees and re-invigorate pili grass; however other fire-adapted non-native plants may thrive along with pili (Loh and McDaniel 2010).

### **Fire Ecology and Management Inside and Outside the Park**

Changes in land use (e.g., deforestation for logging and grazing) and the spread of invasive plant species have altered the role of fire in Hawaiian ecosystems. In many cases, fire is carried by invasive plants, particularly grasses. Invasive plant species often respond favorably after fire and compete with recovering native plant species. The degree to which this happens varies by ecosystem (refer to the "Vegetation" section of chapter 3 for more detail). The worst-case scenario is in the mid-elevation seasonal woodlands. Fire is carried by fire-adapted non-native broomsedge, beardgrass, and molasses grass. These species recover rapidly after fire, suppressing native species recovery (NPS 2004b). In addition, increased human-caused fires, including arson, contribute to direct loss of native plant species while promoting the growth of non-native species, which leads to habitat fragmentation. Fire also contributes to the direct loss of cultural resources.

In the 1980s, the NPS established a fire management program based at Hawai‘i Volcanoes National Park (see the “Fire Management Division” section in chapter 3); and a comprehensive fire management plan for the park was developed to address the threat of wildfire to human life, property, and cultural and natural resources (NPS 2005a, 2007b). The current fire management plan divides the park into seven fire management zones that reflect the different ecological zones. Within each zone, the potential for wildfire, fire history, fire impacts, resources at risk, and appropriate management strategies are identified. Because of the largely negative effects of fire on natural and cultural resources, the park has adopted an aggressive fire suppression policy. Implementation of the fire management plan by fire staff include monitoring for fire severity conditions and wildfires, implementing temporary restrictions and closures during times of high fire severity, maintenance of fuel breaks and water catchments, conducting fuel treatments and maintaining a trained militia made up of park staff and individuals from the community to respond to wildfire emergencies. For several burn areas, the park has developed prescriptions for restoring native plant communities following wildfire (Loh et al. 2007; Loh et al. 2009; McDaniel et al. 2008).

The communities of Ocean View and Volcano in Hawai‘i County lie adjacent to the park and are within the wildland/urban interface environment, which is where wildlands meet houses and communities. The wildland/urban interface poses the highest risk of loss of life and property due to wildland fires. Wildland fires originating in the park can threaten the communities of Volcano and Ocean View, including homes along Lorenzo Road in Ka‘ū, Volcano Village, and the Volcano Golf Course Community. Conversely, fires started in these neighboring communities could also impact the park. To reduce the threat of wildfire in the park and adjacent communities, the communities of Ocean View and Volcano have developed community wildfire protection plans cosponsored by the park and the Big Island Wildfire Coordinating Group (Laitinen 2006a, 2006b). These community wildfire protection plans outline the following mitigation measures to reduce damage from future wildfires: (1) installation of pre-staged static water tanks; (2) increased communication to residents regarding evacuation during an emergency; (3) creation/improvement of secondary access and ingress/egress roads, including identification of evacuation route roads within subdivisions; (4) reduction of fuel load along roadsides and in common areas; (5) reduction of non-native species that increase fire risk; (6) continued fire-prevention education and outreach; and (7) strengthening of Hawai‘i County fire ordinances. The park currently maintains a fuel break along a portion of its shared boundary with the Volcano Golf Course community and is working with the community of Hawaiian Ocean View Estates to contain the spread of invasive fountain grass, a fire-promoting species, along subdivision roads. Also, the park has memoranda of understanding with the state and county of Hawai‘i to provide mutual assistance in the event of large-scale wildfires in and around the park.

### **Management Related to Cultural Resources, Including Historic Properties**

Many of the past and present actions for cultural resources are described in chapter 3. In addition to monitoring and protection of archeological features and cultural landscapes, the NPS has considered cultural resource values to protect and preserve traditional activities in park management actions. The NPS maintains access to sacred sites for traditional activities and integrates cultural values into management strategies for resources such as cultural landscapes and traditional cultural properties. In addition, the park carries out inventory and documentation of historic resources and cultural landscapes in the park, as well as identification of new cultural sites for interpretation and public access. The latter would contribute to cumulative effects on these resources, as well as on visitor use and experience.

### **Other Park Management Plans/Actions**

Within the park, a variety of activities have been conducted that may contribute to cumulative impacts, such as various research, issuing special use permits, managing assets, and purchasing materials on the island. Law enforcement, maintenance, interpretive activities, and other visitor services, which are

described in the “Park Management and Operations” section of chapter 3, may also have contributed to cumulative impacts, including when visitors encounter such activities in the park (e.g., search and rescue operations) or as a result of access restrictions (e.g., volcanic emissions). Hawai‘i Volcanoes National Park has offered a variety of interpretive programs that discuss the unique history of the park. In relation to non-native ungulate management, interpretive displays in the visitor center and on the park’s website have provided information about these species.

In addition to park staff, volunteers have been used for a variety of activities throughout the park to assist with interpretive, cultural, and natural resource programs. Activities that involve the use of volunteers have the potential to affect park management and operations due to the oversight needed. Volunteer activities related to natural resources have included planting, removal of non-native plant species, monitoring endangered hawksbill turtles and nēnē, and assisting with non-native ungulate removal efforts at the Kahuku Unit. In addition to volunteers, many park employees come from the local communities surrounding the park (NPS 2006d). The volunteer program has provided opportunities for community members to participate in stewardship of park resources. The majority of volunteers that have participated in non-native ungulate management actions in the park have been island residents.

Law enforcement activities at the park have included protecting natural and cultural resources from poaching and harvesting, as well as enforcing general laws, rules, and regulations. Also, law enforcement personnel have conducted search-and-rescue operations and assisted with wildland firefighting.

Descriptions of many of the park management plans that will contribute to cumulative impacts are provided in chapter 1. In addition to these, are several plans in development described below.

***Hawai‘i Volcanoes National Park Air Tour Management Plan.*** Hawai‘i Volcanoes is working with the Federal Aviation Administration (FAA) to develop an ATMP and EIS to determine acceptable and effective measures to mitigate or prevent the adverse impacts, if any, of commercial air tour operations on the park’s natural and cultural resources (including Native Hawaiian practices) and visitor experience. A commercial air tour operation is defined as a flight conducted for compensation or hire in a powered aircraft where the purpose of the flight is sightseeing over a national park, within 0.5 mile of the boundary of any national park, or over tribal lands, during which the aircraft flies below a minimum altitude of 5,000 feet (1,524 meters) above ground level (AGL), or less than 1 mile laterally from any geographic feature in the park. In accordance with the *National Parks Air Tour Management Act*, the Hawai‘i Volcanoes National Park ATMP may prohibit commercial air tour operations in whole or in part, and may establish conditions for conducting commercial air tour operations, among other stipulations (FAA n.d., 2004, 2005). Future implementation of the plan will likely affect park management and operations, visitor use and experience, soundscapes, and visitor and employee safety.

***Hawai‘i Volcanoes National Park General Management Plan/Wilderness Study.*** The NPS is preparing a GMP/Wilderness Study and EIS to guide management of the park for the next 20 years. The GMP/Wilderness Study will address critical issues at the park, including planning for visitor services and park operations in a constantly changing volcanic landscape; natural resource preservation and restoration, protection of federally listed species; cultural resource protection and management; Native Hawaiian traditional use; transportation and congestion; and global climate change (NPS 2009d). The GMP/Wilderness Study will include a commercial services strategy; plans for visitor services and resource protection; and a wilderness study for the entire park, including the recently acquired Kahuku unit. Future implementation of the GMP/Wilderness Study will involve prescriptions for desired conditions related to the protection of natural resources balanced with those for visitor use, and will likely affect all the impact topics addressed in this plan/EIS.

***Ala Kahakai National Historic Trail Comprehensive Management Plan/Environmental Impact Statement.*** The Ala Kahakai NHT extends approximately 175 miles from ‘Upolu Point on the northern tip of the Island of Hawai‘i down the Kona Coast and around South Point to the eastern boundary of Hawai‘i Volcanoes National Park. Sections of the historic trail are located within Hawai‘i Volcanoes. Completed in 2004, the comprehensive management plan for the Ala Kahakai NHT establishes the management guidelines needed to fulfill the preservation and public use goals for the NHT for approximately the next 15 years (NPS 2004d). The plan is based on the trail’s purpose and its significant attributes, stories, and experiences, and is guided by the community vision for the trail. This plan offers strategies for resource protection, trail use, and facility development. The plan serves as the umbrella document under which more implementation plans will be prepared in the future. Future implementation could provide more opportunities for recreation, increase awareness of the island’s unique natural and cultural resources, and support the local economy and tourist industry. The NPS, through the Ala Kahakai NHT office, will provide overall administration, coordination, and oversight of the Ala Kahakai NHT as directed by Congress, with an emphasis on ensuring consistency of preservation efforts, trail management operations, and development and maintenance standards, as well as conformance with applicable laws, regulations, and policies.

**Proposed Mauna Loa Trail System (Ongoing Feasibility Study).** A Mauna Loa trail system feasibility study, sponsored by The Hawai‘i Tourism Authority, Kamehameha Schools, and TNC, was completed in 2005 (TNC 2005). The purpose of this study was to plan, describe, and assess the feasibility of a mid-elevation trail system around the slopes of Mauna Loa on the Island of Hawai‘i. The “working” name of this network of trails is the Mauna Loa Trail System. The proposed 350-mile trail system would tie into and incorporate existing trails and 4-wheel-drive roads on public and private lands. Parts of the trail system are in Hawai‘i Volcanoes National Park. Future implementation would provide more opportunities for recreation, increase awareness of the island’s unique natural and cultural resources, and support the local economy and tourist industry. Also, implementation would require close collaboration among public agencies, community organizations, and landowners; infrastructure improvements (e.g., parking, rest stops, information signs, maintenance/of existing 4-wheel-drive roads and trails, and construction of connector trails); and additional measures to provide for visitor safety, interpretation, and protection of natural and cultural resources.

#### **Other Conservation Actions/Plans Outside the Park**

**Threatened and Endangered Species Recovery Plans.** Many of the USFWS and National Oceanic and Atmospheric Administration recovery plans that have been developed for listed threatened and endangered species recommend the removal of non-native animals and building exclosures to protect these plants and animals. Plans that were considered in preparing this non-native ungulate management plan include the following: *Revised Recovery Plan for Hawaiian Forest Birds* (USFWS 2006a), *Final Recovery Plan for Four Species of Hawaiian Ferns* (USFWS 1998a), *Recovery Plan for the Ka‘ū Silversword* (USFWS 1996b), *Recovery Plan for the Big Island Plant Cluster* (USFWS 1996a), *Recovery Plan for the Multi-island Plants* (USFWS 1999), *Big Island II: Addendum to the Recovery Plan for the Big Island Plant Cluster* (USFWS 1997), *Draft Revised Recovery Plan for the Nēnē or Hawaiian Goose* (USFWS 2004), *Revised Recovery Plan for the ‘Alalā (Corvus hawaiiensis)* (USFWS 2009d), *Recovery Plan for the Hawaiian Hoary Bat* (USFWS 1998b), *Hawaiian Hawk Recovery Plan* (USFWS 1984), *Hawaiian Dark-rumped Petrel and Newell’s Manx Shearwater Recovery Plan* (USFWS 1983) and *Recovery Plan for the U.S. Pacific Population of the Hawksbill Turtle* (NMFS and USFWS 1998).

The USFWS Pacific Islands Ecoregion, partnering with the State Division of Forestry and Wildlife, is in the early phases of planning for the reintroduction of the federally listed endangered ‘Alalā, or Hawaiian crow. The bird is extinct in the wild and individuals are currently being reared in captivity at Keauhou Bird Conservation Center and at Maui Bird Conservation Center. Areas in and adjacent to Kahuku are

identified as potential release sites that may require non-native ungulate control measures to protect habitat.

**Three Mountain Alliance.** The TMA is a watershed management partnership composed of nine members: Kamehameha Schools; TNC; the State Department of Corrections Kūlani Correctional Facility; the DLNR Division of Forestry and Wildlife; the USFS, NRCS, NPS, USFWS, and USGS. The overall management goal of the TMA has been to sustain the multiple ecosystem benefits provided by the three mountains of Kīlauea, Mauna Loa, and Hualālai by responsibly managing its watershed areas; native habitats and species; and historical, cultural, and socioeconomic resources for all who benefit from the continued health of the three mountains. Management programs have been developed to support these overall goals and include the following: habitat protection and restoration, watershed protection, compatible economic use, compatible recreation and ecotourism, education, awareness and public outreach, cultural and historical resource protection and research and monitoring that will support conservation management and recovery programs (TMA 2007, 2009; ‘Ōla‘a-Kīlauea Management Group 1999; ‘Ōla‘a-Kīlauea Partnership 2007). Many of the activities that have been implemented on the ground are described in this chapter under “Past, Current, and Future Actions in and Around Hawai‘i Volcanoes” in the section titled “Non-native Plant and Animal Species Management Outside the Park, Including Fencing and Game Management.”

**Hawai‘i Department of Land and Natural Resources.** The DLNR has been conducting a plant habitat management project within various Natural Area Reserves on the Island of Hawai‘i. The goals of the project has been to (1) protect and stabilize the ecosystem for native rare and endangered species, (2) fence areas to protect vegetation from predators, (3) control/eradicate non-native plant species, and (4) increase rare species populations by planting. Natural Area Reserve staff members have been working on fencing protected areas to keep non-native ungulates out of native areas. In the Kīpāhoehoe Natural Area Reserve, the maintenance of perimeter fences has been ongoing. Staff members at Kīpāhoehoe have also planted native plant species, and contributed to fire prevention by removing weeds along roads to prevent fires from spreading, and building water catchment systems in strategic locations to assist in fighting fires. In the Wright Road Unit of the Pu‘u Maka‘ala Natural Area Reserve, ungulate control efforts were completed, and planting and weed removal begun. In the Manukā Natural Area Reserve, efforts to control ungulates have been ongoing in upland areas (HDLNR n.d.b).

Please refer to the “Land Management Adjacent to the Park” section in chapter 3 and this chapter in the section titled “Non-native Plant and Animal Species Management Outside the Park, Including Fencing and Game Management” for descriptions on additional management actions and plans outside the park.

### **Development inside the Park, Including Land Clearing (Logging, Ranching, Agricultural Use), Fragmentation, and Loss of Vegetation**

The development and maintenance of facilities at the park contribute to cumulative impacts. Facilities at the park include but are not limited to trails, roads, and structures (e.g., culverts, buildings, cabins, and shelters), some of which are historic; park rights-of-way (along roads and for utilities); campgrounds; parking lots; water catchment systems; and facilities associated with concessions and administrative support. At any time, maintenance of facilities, especially along roads, has the potential to affect visitor use and experience by restricting access and/or increasing traffic, which causes delays.

Various agricultural and logging activities, including ranching, have occurred historically in the park. These activities have resulted in land clearing and impacts from grazing that have contributed to fragmentation of habitat and loss of native vegetation. Kahuku, which was transferred to the NPS in 2003, was formally a cattle ranch. Large areas of native forest were commercially harvested and converted to grazing land, with the most damage occurring below 3,000 feet in elevation (914 meters) (NPS 2008d).

The interim operating plan for the Kahuku Unit (NPS 2006a) outlines measures that could be taken to improve natural resources, cultural resources, and visitor experience in this portion of the park. This plan highlights three actions related to roads and trails in Kahuku: (1) establish a safe access road into the Kahuku district; (2) maintain roads and trails determined to be necessary to interim operations of the area, including (but not limited to) grading, filling, construction of water bars, and mowing center islands; and (3) continue inventory and mapping of existing roads and trails for determination of future use (NPS 2006a). The GMP (in progress) will also identify additional uses and facilities in the park.

### **Development Outside the Park, Including Land Clearing (Logging, Ranching, Agricultural Use), Fragmentation, Urbanization, and Loss of Vegetation**

The park lies adjacent to several state forest reserves, Kamehameha School, and large private landholdings (e.g., TNC, Yee Hop, Hawai'i Outdoor Tours). While state forest reserves are relatively undeveloped, other areas have been extensively cleared for ranching and logging (e.g., Kapāpala Ranch, Yee Hop). In the Volcano Village area, there are several small plant nurseries and farms, a vineyard, and the Agricultural Experiment Station of the University of Hawai'i (Loh, pers. comm., 2009a). The communities of Volcano in the Puna District and Ocean View in the Ka'ū District border the park. The Puna community is located on the eastern side of the Big Island of Hawai'i, and shares borders with the South Hilo District to the north and Ka'ū District to the west. The County of Hawai'i approved the *Puna Community Development Plan* in September 2008 (Puna Community 2008). This plan outlines several goals, objectives, and actions to be taken for managing growth in Puna. The plan proposes to retain a rural character while protecting native and cultural resources, to reduce the overall number of buildable lots, and to prevent further sprawl. The first draft of the Ka'ū community development plan is currently in development. The Ka'ū community development plan is intended to cover the 13 elements of the general plan (County of Hawai'i 2005): economic, energy, environmental quality, flooding and other natural hazards, historic sites, natural beauty, natural resources and shoreline, housing, public facilities, public utilities, recreation, transportation, and land use.

In the future, general population increases and shifts in the demographic composition outside the park could result in continued development of retirement and second homes, ultimately resulting in increased urbanization. The most recently proposed residential and resort development, Kahuku Villages, is located below the Kahuku unit of the park (PBR Hawaii 2009). Increased urbanization can potentially contribute to habitat fragmentation and the spread of non-native plant species and result in the loss of traditional cultural resources.

### **Acquisition of New Lands (Including Kahuku)**

As described in chapter 1, Hawai'i Volcanoes National Park originally included 35,865 acres (including Haleakalā on the Island of Maui). The area of Hawai'i Volcanoes, not including Haleakalā, was expanded through the years to 333,000 acres. The most recent of these expansions was the acquisition of the Kahuku Unit in 2003, which added approximately 116,000 acres to the park. Boundary expansion and acquisition of new lands creates new management challenges for the NPS, but also helps provide protection for resources that may not have previously existed. All lands considered for future acquisition could potentially be identified in the GMP.

### **Park Visitation**

Park visitation has experienced variation throughout the years, although it has clearly increased since visitation records began being recorded in 1921 (NPS 2009b). Between 1974 and 2010, average annual visitation has been around 1.4 million. However, the park has experienced noteworthy visitation highs and lows, including a decrease from 1984 (which recorded over 2 million visitors) to 1985 (which

recorded 816,652 visitors). Visitation climbed steadily until it experienced another decrease between 1997 and 2002.

Based on past rates of visitation, visitation both inside and outside the park will likely fluctuate throughout the life of this plan. Projected changes in air and ground travel would likely have impacts on local businesses and visitor experience as visitation patterns change. More opportunities for increased local lodging options, such as the establishment of bed and breakfasts in the gateway communities, could replace the more prevalent lodging options farther away in Kona.

The potential for the park to acquire new lands could increase possibilities for visitor use and enhance visitor experience and park visitation. This could result in an increase in park staff from local communities to manage such lands/uses. These changes could also result in longer visitor stays or repeat visitation.

### **Increased Overflights Inside and Outside the Park (Includes Park Administrative Activities, Commercial Air Tours, Administrative Activities of Outside Agencies and Military Overflights)**

Since 1983, the number of airplanes and helicopters flying over national park units has increased dramatically. Much of the increase in flights, which are a substantial source of unnatural sounds in national parks, can be attributed to the growth of the air tour industry (Lawson et al. 2007). In the 1990s, Congress began to address the increasing number of air tours nationwide by mandating the FAA and the NPS to manage air tours over the parks. The *National Parks Air Tour Management Act* of 2000 requires the development of commercial ATMPs for parks in which air tours are conducted. The NPS has been working with the FAA to prepare an ATMP and EIS for Hawai'i Volcanoes National Park. Flights over parks and surrounding areas include commercial air tour flights, park administrative flights, and occasional military overflights. Currently, air tour operators are authorized to conduct more than 28,000 flights annually over the park. In 2009, the number of air tours flying over the park was estimated to be about 15,000 annually. During peak periods of volcanic eruptive activity, the park can experience as many as 60 flights in a 4-hour period at eruption sites. Other agencies, such as the Department of Defense and the Drug Enforcement Agency, the electric company, and the local hospital, all use aircraft that travel over the park and contribute to cumulative impacts.

### **Research Studies and Instrumentation in the Park**

Research studies and instrumentation, including GPS instrumentation, seismographs, battery cases, antennas, and small solar panels, in and outside wilderness areas have been used to study volcanic actions, monitor climate conditions, air quality, and measure changes in ecological conditions and cultural resources. Such studies have been conducted by various federal agencies (including the park), universities and research institutions. The USGS Hawaiian Volcano Observatory and Pacific Islands Ecosystem Research Center are located on the summit of Kīlauea in the park. The former has been conducting long term monitoring of volcanic activity and has instrumentation deployed throughout the park, including designated wilderness, to assist with analysis of geohazards. Scientists from Pacific Islands Ecosystem Research Center, USFS, and various universities have conducted a number of studies monitoring biological resources, geological resources and ecosystem processes. These research studies have involved the use of equipment in the park, including helicopters, which, coupled with the presence of researchers, could impact wilderness areas, visitor use, and other park resources (NPS 2008d). Inside the park are several weather and air quality monitoring stations and radio repeaters deployed in various areas to assist park operations and visitor safety.

### **Increased Investment in the Local Economy**

The NPS has contributed to the local economy by providing jobs to park employees, including seasonal, term, and permanent full-time or part-time positions (see the “Park Management and Operations” section in chapter 3 for more detail). Many of the employees are hired from the resident population on the island. Park employees spend their income and wages in the local economies, which supports additional jobs and income. In 2007, Hawai‘i Volcanoes National Park employed 144 full-time and part-time employees, who supported an additional 59 jobs in the local economy, for a total of 203 part-time and full-time jobs (Stynes 2008). This payroll spending contributes to the value added, or the island’s gross regional product, by an estimated \$10.9 million. Also, the NPS supports the local economy when local vendors are used for purchases, supplies, and/or contracted services, such as fencing supplies.

### **Park Education and Stewardship Programs; Ranger-led Interpretation Activities**

Park staff have offered a wide range of ranger-led interpretation programs as well as other educational and stewardship programs. For more information related to these programs, please refer to the “Primary Interpretive Themes” section in chapter 3.

### **Closures Due to Volcanic Activity**

Volcanic activity, including eruptions and smoke and ash plumes, has generally been commonplace at the park. Kīlauea, located within Crater Rim Drive, is one of the world’s most active volcanoes. These volcanic activities have required quick responses by park management and staff in order to notify visitors and protect visitors and natural and cultural resources. Area closures due to volcanic activity have been sporadic and difficult to predict.

## **IMPACT TOPICS**

### **VEGETATION**

#### **GUIDING REGULATIONS AND POLICIES**

The NPS *Organic Act* of 1916 and the NPS *Management Policies 2006* (NPS 2006b) direct parks to provide for the protection of park resources. The NPS *Management Policies 2006* states that the NPS “will try to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and genetic and ecological integrity of the plant and animal species native to those ecosystems” (NPS 2006b, Section 4.1). In addition, the NPS *Management Policies 2006* prohibits the displacement of native species by exotic species if displacement can be prevented (Section 4.4.4). As described in chapter 1, Section 4.4.4 also places a high priority on the control, including complete removal, of non-native species that have, or potentially could have, a substantial impact on park resources, including natural processes and the perpetuation of natural features, native species, or natural habitats.

The park’s resource management goals, as articulated in several plans described in the “Relationship to Hawai‘i Volcanoes National Park Planning Documents” section of chapter 1, also call for the protection of native vegetation in light of the damage caused by non-native ungulates. See chapter 1 for more details on these plans and their management goals.

## METHODOLOGY, ASSUMPTIONS, AND IMPACT THRESHOLDS

Baseline information, including the condition and composition of the vegetation at Hawai'i Volcanoes National Park, was identified using maps and descriptions of the plant communities within the different ecological zones from the park's fire management plan (NPS 2005a). Information on non-native ungulate habitat and vegetation use was reviewed to identify which plant communities could be affected by management actions as well as by the presence of non-native ungulates themselves. This included reviewing areas currently managed for ungulates, and where recovery and active restoration is ongoing.

Recognizing that non-native ungulates not only cause the damage and removal of native plants, but also spread the seeds of non-native vegetation and create disturbances that facilitate their establishment, the analysis focuses on the impacts both to individual plants and to the plant communities they are part of. As described in chapter 1 and reiterated by the science team that convened for this project, the presence of even small populations or individuals of non-native ungulates has the potential to impact vegetation, including effects on natural function and character of native species (i.e., growth, abundance, reproduction, distribution, structure, composition or diversity), as well as plant community properties (i.e., size, integrity, continuity, or succession). Consequently, the removal of non-native ungulates is assumed to result in benefits to the natural function and character of plants, as well as plant community properties. However, the analysis also considers potential adverse effects of removing non-native ungulates, such as reduced grazing pressure on non-native weeds, which could increase in abundance and cause changes to fuel loads and fire regimes.

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*Consequently, the removal of non-native ungulates is assumed to result in benefits to the natural function and character of plants, as well as plant community properties. However, the analysis also considers potential adverse effects of removing non-native ungulates, such as reduced grazing pressure on non-native weeds, which could increase in abundance and cause changes to fuel loads and fire regimes.*

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Impact intensity thresholds were defined for adverse impacts. For this plan/EIS, assignment of intensity levels for vegetation impacts are based on the potential for changes to such characteristics as follows:

- Negligible:* Individual plants may be affected, but measurable or perceptible changes in the natural function and character of the plant community in terms of growth, abundance, reproduction, distribution, structure, or diversity of native species would not occur.
- Minor:* Effects on multiple plants would be measurable or perceptible. However, the natural function and character of plant communities in terms of growth, abundance, reproduction, distribution, structure, or diversity of native species would only be perceptible in small localized areas.
- Moderate:* A change would occur in the natural function and character of the plant communities in terms of growth, abundance, reproduction, distribution, structure, or diversity of native species, but not to the extent that plant community properties (i.e., size, integrity, or continuity) change.
- Major:* Effects on plant community properties (i.e., size, integrity, or continuity) would be readily apparent and would substantially change the natural function and character of the vegetation community (i.e., growth, abundance, reproduction, distribution, structure, or diversity of native species).

## IMPACTS OF THE ALTERNATIVES

### **Alternative A: No Action (Continue Existing Non-native Ungulate Management Activities)**

#### **Analysis**

In areas where ungulates are being managed, short-term adverse impacts on vegetation include those associated with temporary ground-based management actions (e.g., the presence of humans placing bait stations, shooting ungulates, setting traps and snares, and monitoring and collecting data, as well as constructing and repairing fences), including foot traffic and fence placement. Foot traffic would have the potential to affect individual plants, and a four-foot wide corridor of vegetation could be cleared to install fences, but these activities would not alter the natural function or character of plant communities. In addition, fence alignments are located to minimize impacts on native vegetation and to avoid impacts on rare or sensitive vegetation.

In areas where ungulates remain on the landscape, removal of animals would support recovery of native vegetation. Studies conducted inside and outside the park show that non-native ungulate removal is an essential first step in the restoration of native Hawaiian vegetation. Removal of animals prevents further loss of native vegetation by herbivory, rooting and trampling. In rain forest, pigs selectively browse or uproot native mints, shrubs, and tree ferns, suppressing native vegetation and facilitating the spread of non-native plants. Following removal of pigs, native understory vegetation recovers rapidly, and subcanopy tree ferns and native trees begin to regenerate more rapidly in the absence of pigs (Loh and Tunison 1999). In former koa forest on Mauna Loa, exclusion of non-native goats and cattle assists native forest recovery and allows additional measures, such as planting of rare species and understory restoration efforts, to take place (McDaniel et al. 2011; Tunison et al. 1994; Tunison et al. 1995). In portions of Kahuku, release from browsing pressure by the removal of mouflon has led to vigorous recruitment of koa and, to a lesser extent, other native plant species (HDLNR 2005c).

Removal of ungulates would assist park managers with control of non-native weed infestations (Tunison and Stone 1992). Non-native ungulates facilitate the spread of invasive non-native weeds by dispersing seeds of non-native species and creating vegetation openings for non-native plants to establish (Diong 1982; Lipp 1994; Stratton 1996). However, following the removal of ungulates non-native weed distributions and abundances may increase depending on habitat type, ecosystem vulnerability, existing threats, and other factors. For example, following pig removal from a rain forest unit, recovery of understory native vegetation (from 21 to 46 percent vegetation cover abundance) was accompanied by an increase in non-native weeds (from 2 to 11 percent vegetation cover abundance) (Loh and Tunison 1999). In contrast, several studies conducted in recovery sites around the state found no net difference in weed abundance following removal of feral animals, with some plant species decreasing or increasing in abundance. Often, the spread of non-native plant species occurred in spite of ungulate removal, not because of it (Aplet et al. 1991; Scowcroft and Conrad 1992; Stone et al. 1992). Implementation of weed control measures (see chapter 2) through existing plans would limit the potential adverse effects of non-native weeds on vegetation.

As vegetation recovers, fire risk may increase in certain (but not all) areas. For example in the coastal lowland wildfires increased in frequency and size when short-statured non-native grasses were replaced by tall fire-adapted non-native grasses following removal of animals (Tunison et al. 2001). In contrast, fire risk did not change in the mid-elevation seasonal woodlands. This is because fire-promoting non-native broomsedge and bush beard grass established and spread while goats were still present. Animals preferred to forage on native plants over the non-native grasses (Baker and Reeser 1972). Following goat exclusion, grasses remained abundant and fire risk remained high. Occurrence of wildfire has remained infrequent in the Mauna Loa montane zone despite the build-up of vegetation following release from

grazing pressure by animals, and in the subalpine zone. Areas in the park that contain animals and are potential concerns for increased fire risk following their removal include montane naio-māmane woodlands in Kahuku and former koa-‘ōhi‘a forest in Kahuku that has been converted to pasture. However, keeping grazing animals on the landscape and allowing further loss of native vegetation would hinder the ability of native vegetation to recover after wildfires. In some areas, removing non-native animals would assist recovery of native plant communities and restoration of natural fire regimes. For example, re-establishment of a dense native plant understory could create more humid conditions that are less conducive for carrying wildfire (Freifelder et al. 1998). Implementation of fuel reduction treatments, monitoring and wildland fire suppression activities described in existing plans (see chapter 2), and weed sanitation protocols to prevent establishment and spread of new invasive species, would limit the potential adverse effects of non-native weeds and an altered fire regime on vegetation.

In addition to protecting and restoring native species and plant communities, removing non-native ungulates and restoring native vegetation cover would also help to counteract potential pressures of global climate change on vegetation. As noted in the “Vegetation and the Role of Climate Change” section of chapter 3, changes in temperature and moisture regimes may result in dramatic shifts in habitat range for a number of native plant and animal species and vegetation types, and the movement of invasive species (EPA 1998; Giambelluca et al. 2008; Nadkarni and Solano 2002; Root et al. 2003). Management of non-native ungulates would remove a key stressor on native ecosystems, thereby increasing the capacity of native species to adapt to changes in climate (NPS 2010c). Restoration of fragmented plant communities would restore habitat continuity and allow for the local migration of species in response to climate change. Also, removing ungulates would reduce the disturbance-facilitated establishment of non-native weeds, and remove a mechanism for their dispersal.

In summary, alternative A would result in short- and long-term negligible to minor adverse impacts on vegetation through implementation of ground-based management actions. In areas of the park already managed for ungulates, alternative A would produce negligible adverse impacts because the frequency and duration of management actions in these areas would be minimal. In these areas of the park, long-term beneficial impacts on vegetation would result from the continuation of animal exclusion in managed units. However, long-term beneficial impacts to the native vegetation would be unlikely for Kahuku and areas currently unmanaged (e.g., portions of ‘Ōla‘a), for which no established population-level objective and fencing strategy has been identified. Also, the implementation of management tools and monitoring would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities. Because alternative A would not incorporate the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, it would be uncertain whether the NPS would progress through management phases, monitor, and apply management tools consistently as staff and institutional knowledge change over time.

### **Cumulative Impacts**

Other past, present, and reasonably foreseeable future actions in and around the park have affected or could affect native vegetation. Past actions parkwide (since 1974), include development of facilities (e.g., water reservoirs, building and road improvements); maintenance of landscaped areas, including cultural landscapes (e.g., historic gardens and lawns); and the management of cultural resources, including historic properties. Although management plans ensure protection of sensitive species and native habitat, future activities associated with the development and maintenance of facilities (grading, filling, construction, and inventory) at the park, including trails and roads, could contribute to localized trampling and removal of vegetation and short-term to long-term adverse impacts. Visitation at the park could also contribute to localized trampling of vegetation and introduction of non-native weeds if visitors wander off designated trails. In Kahuku, past actions including agricultural operations (including cattle grazing) and logging have resulted in large-scale land clearing and habitat fragmentation contributing to loss or

degradation of native vegetation, particularly in lower-elevation areas (less than 5,000 feet in elevation (1,524 meters)). Past actions adjacent to the park include increased land clearing due to urbanization, agriculture, and logging. Grazing and urbanization adjacent to the park continue today, resulting in land clearing and vegetation loss. Land clearing, grazing, and adjacent urbanization in the future would continue to adversely impact native vegetation.

Changes in the fire regime due to habitat fragmentation and non-native species invasions pose a threat to native vegetation. Particularly in dry and seasonally dry vegetation types, fire is promoted by non-native plants and many non-native plant species recover quickly after fire, suppressing native species recovery (Hughes and Vitousek 1993; Tunison et al. 2001). In addition, increased human-caused fires contribute to direct loss of native vegetation. However, the park's fire management plan (NPS 2005a) outlines procedures and approaches for the monitoring and suppression of wildfires, mitigation measures to reduce the chance of wildfire, and maintenance and restoration of natural resources (see the "Past, Current, and Future Actions in and Around Hawai'i Volcanoes" section in this chapter). The NPS and the Big Island Wildfire Coordinating Group have cosponsored community wildfire protection plans, which have been developed for local communities in the vicinity of the park, outlining mitigation measures to reduce the chances of wildfire occurring in these communities and the park (Laitinen 2006a, 2006b).

Many past, current, and future actions, plans, and programs at the park and surrounding areas provide benefits for native vegetation. Past actions such as fencing to exclude non-native ungulates have resulted in native vegetation recovery in many places of the park (these fencing efforts are discussed in chapter 1 and as an element common to all alternatives in chapter 2). The current weed management program, which includes monitoring and removal of incipient weeds, will address new weeds that may enter the park and contain the spread of highly invasive weeds into high-priority areas. The acquisition of the Kahuku Unit resulted in increased protection of natural resources in these lands by implementation of management actions under the interim operating plan. During the last 20 years, members of the TMA (formerly 'Ōla'a-Kīlauea Partnership) have constructed fences, excluded non-native ungulates, controlled weeds, and planted native vegetation in several areas adjacent to or near the park, which has resulted in recovery of native vegetation (see the "Past, Current, and Future Actions in and Around Hawai'i Volcanoes" section in this chapter). The HDLNR, a TMA member, has implemented measures for fire prevention by removing weeds along roads to prevent fires from spreading, and by establishing water catchment systems in strategic areas to assist in fighting fires. Natural resource and watershed protection on lands in and adjacent to the park has previously supported and will continue to support the protection and recovery of native vegetation.

The future implementation of the GMP (currently in development) for the park will also involve prescriptions for desired conditions related to the protection of natural resources balanced with those for visitor use. However, areas adjacent to the park that are not managed for the conservation of native wildlife will likely continue to degrade due to the uncontained spread of non-native plant species and ongoing impacts caused by non-native ungulates.

Additional actions providing benefits for vegetation include park educational programs and interpretation activities, the implementation of USFWS recovery plans for sensitive species, and revegetation and sensitive species specific restoration activities. The overriding goal of these programs is the perpetuation of native ecosystems and the recovery of biological diversity in the park. The main strategies for accomplishing these goals are monitoring of rare populations, propagation and planting of individuals, and protection of habitat through removal of disruptive non-native species.

Some past, current, and future actions contribute to both beneficial and adverse impacts, depending on what stage of implementation they are in. For example, construction and maintenance of fences in the park would contribute to localized adverse impacts (due to corridor clearing for fences), but would also

contribute to beneficial impacts once the fences are erected by keeping non-native ungulates out of fenced areas and assisting vegetation recovery across the larger landscape. Likewise, law enforcement activities would contribute to beneficial impacts by protecting vegetation from being damaged by visitors who wander off trails, but also would contribute to localized adverse impacts if law enforcement staff members need to go off trail.

The overall impacts of past, present, and future actions (inside and outside the park) on vegetation would be long-term beneficial and short- and long-term minor to moderate adverse. When combined with the impacts under alternative A, there would be short- and long-term minor to moderate adverse cumulative impacts on vegetation. Long-term beneficial cumulative impacts would be less likely under alternative A, because non-native ungulate management within the park would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

### **Conclusion**

Under alternative A, short- and long-term negligible to minor adverse impacts would result from the implementation of ground-based management actions. In areas of the park already considered ungulate free, alternative A would produce negligible adverse impacts because the frequency and duration of management actions in these areas would be minimal; and long-term beneficial impacts on vegetation would result from the continuation of animal exclusion. Long-term beneficial impacts would be unlikely for Kahuku and areas currently unmanaged (e.g., portions of ‘Ōla‘a), where no established population-level objective or fencing strategy has been identified in a comprehensive and systematic plan. The effects of alternative A, when combined with impacts of past, present, and reasonably foreseeable future actions on vegetation, would have short- and long-term minor to moderate adverse cumulative impacts on vegetation. Long-term beneficial cumulative impacts would be less certain under alternative A, because non-native ungulate management would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

### **Alternative B: Comprehensive Management Plan that Uses Lethal Removal Techniques**

#### **Analysis**

Removal of animals would result in long-term beneficial impacts on vegetation due to release from browsing pressure, rooting and trampling, as well as ecosystem restoration and recovery. Long-term beneficial impacts to vegetation would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

Where ungulates are managed, short-term negligible to minor adverse impacts on vegetation would include those associated with temporary ground-based management actions (e.g., the presence of humans on foot, installing bait stations, setting traps and snares, and monitoring and collecting data, as well as constructing and repairing fences). The duration and frequency of actions and their associated impacts would decrease over the life of the plan as desired conditions are reached and the park moves from reduction into less intensive management phases.

The removal of ungulates could cause an increase in some non-native weeds, resulting in long-term adverse impacts on native plants and plant communities depending on a variety of factors. Also, fire risk could increase in certain areas where grazers and browsers are removed, while for other areas fire risk could decrease or remain unchanged. The implementation of weed and fire management programs (see chapter 2) through existing plans, and weed sanitation protocols to prevent establishment of invasive species, would limit the potential adverse effects of non-native weeds and an altered fire regime on vegetation.

Additionally, removal of non-native ungulates and restoration of native vegetation cover helps to counteract potential pressures of global climate change on vegetation by removing a key stressor on native ecosystems, helping reduce habitat fragmentation, and lessening disturbance-facilitated establishment of non-native weeds and their dispersal.

In summary, alternative B would result in short- and long-term negligible to minor adverse impacts on vegetation through implementation of ground-based management actions. Long-term beneficial impacts to vegetation would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

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*Removal of non-native ungulates and restoration of native vegetation cover helps to counteract potential pressures of global climate change on vegetation by removing a key stressor on native ecosystems, helping reduce habitat fragmentation, and lessening disturbance-facilitated establishment of non-native weeds and their dispersal.*

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### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative B would be the same as alternative A. The short- and long-term minor to moderate adverse and long-term beneficial impacts of past, present, and future actions, when combined with the impacts of implementing alternative B, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts on vegetation. Under alternative B, long-term beneficial impacts to vegetation would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Conclusion**

Under alternative B, short- and long-term negligible to minor adverse impacts on vegetation would result from the implementation of ground-based management actions. In areas of the park already managed for ungulates, alternative B would produce negligible adverse impacts because the frequency and duration of management actions in these areas would be minimal. Long-term beneficial impacts to vegetation would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

The effects of alternative B, when combined with impacts of past, present, and reasonably foreseeable future actions on vegetation, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

## **Alternative C: Comprehensive Management Plan that Maximizes Efficiency by Expanding Lethal Removal Techniques and Discontinuing the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative C would result in short- and long-term negligible to minor adverse impacts on vegetation through implementation of ground-based management actions. Long-term beneficial impacts to vegetation would be fully realized under this alternative.

Because lethal techniques would be expanded and enhanced, and volunteers would not be used during direct reduction efforts under alternative C, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative B. The increased efficiency associated with discontinuing the use of volunteers is based on additional work required by NPS staff to recruit, administer, train and direct volunteers in the field, and data that show that park staff remove more ungulates per day when they conduct direct reduction (ground shooting) themselves, compared to when they are accompanied by volunteers (Stephens et al. 2008). Based on past participation, discontinuing the use of volunteers in other activities related to ungulate management (fence building, monitoring, baiting) would not noticeably affect the ungulate program, as volunteer interest in these activities has been infrequent and focused on the more accessible areas of the park, which limits the efficiency gained by using volunteers.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative C would be the same as alternative A. Similar to alternative B, the short- and long-term minor to moderate adverse and long-term beneficial impacts of past, present, and future actions, when combined with the impacts of implementing alternative C, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts on vegetation.

### **Conclusion**

Under alternative C, short- and long-term negligible to minor adverse impacts on vegetation would result from the implementation of ground-based management actions. Long-term beneficial impacts to the vegetation would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative C than under alternative B. The effects of alternative C, when combined with impacts of past, present, and reasonably foreseeable future actions on vegetation, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

## **Alternative D: Comprehensive Management Plan that Maximizes Flexibility of Management Techniques**

### **Analysis**

Similar to alternative B, alternative D would result in short- and long-term negligible to minor adverse impacts on vegetation through implementation of ground-based management actions. Long-term beneficial impacts to vegetation would be fully realized under this alternative.

Under alternative D, it is possible that increased human and vehicular traffic associated with potential relocation activities could cause additional vegetation disturbance during the process of driving animals to

adjacent lands. However, these impacts would be short-term and localized, and similar to impacts of other ground-based management actions.

Although the expansion and enhancement of lethal removal techniques under alternative D would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the continued use of volunteers and the expansion of non-lethal techniques would counteract this to some extent. Inclusion of non-lethal removal would require additional staff time and park resources to relocate animals to adjacent lands, and may increase the time associated with reduction actions over the life of the plan, as well as the time needed to reach the post-reduction phase. As a result, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative D would be the same as alternative A. Similar to alternative B, the short- and long-term minor to moderate adverse and long-term beneficial impacts of past, present, and future actions, when combined with the impacts of implementing alternative D, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts on vegetation.

### **Conclusion**

Under alternative D, short- and long-term negligible to minor adverse impacts on vegetation would result from the implementation of ground-based management actions, including potential relocation activities. Long-term beneficial impacts to the vegetation would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly under alternative D than under alternative C. The effects of alternative D, when combined with impacts of past, present, and reasonably foreseeable future actions on vegetation, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

## **Alternative E: Comprehensive Management Plan that Increases Flexibility of Management Techniques While Limiting the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative E would result in short- and long-term negligible to minor adverse impacts on vegetation through implementation of ground-based management actions. Long-term beneficial impacts to vegetation would be fully realized under this alternative.

Similar to alternative D, it is possible that potential relocation activities could cause additional vegetation disturbance during the process of driving animals to adjacent lands under alternative E.

Although the expansion and enhancement of lethal removal techniques under alternative E would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the expansion of non-lethal techniques would counteract this to some extent. However, because volunteers would not be used during direct reduction efforts under alternative E, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative D, but less quickly than under alternative C.

## **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative E would be the same as alternative A. Similar to alternative B, the short- and long-term minor to moderate adverse and long-term beneficial impacts of past, present, and future actions, when combined with the impacts of implementing alternative E, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts on vegetation.

## **Conclusion**

Under alternative E, short- and long-term negligible to minor adverse impacts on vegetation would result from the implementation of ground-based management actions, including potential relocation activities. Long-term beneficial impacts to the vegetation would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative E than under alternative D, but less quickly than under alternative C. The effects of alternative E, when combined with impacts of past, present, and reasonably foreseeable future actions on vegetation, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

# **NATIVE WILDLIFE AND WILDLIFE HABITAT**

## **GUIDING REGULATIONS AND POLICIES**

The NPS *Organic Act* of 1916, NPS *Management Policies 2006* (NPS 2006b), and NPS *Reference Manual 77: Natural Resource Management* (NPS 1991) 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 is 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* makes 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 2006b).

The Hawai'i Volcanoes National Park GMP (in progress) and resource management plan (NPS 1999a) outline goals related to native wildlife and wildlife habitat that include restoring the park's ecosystems through removal of key non-native species followed by natural recovery and restoration efforts focused on localized areas, which can be expanded to a parkwide scale. See chapter 1 for more details on these plans and their management goals.

## **METHODOLOGY, ASSUMPTIONS, AND IMPACT THRESHOLDS**

The evaluation of wildlife was based on a qualitative assessment of the anticipated impacts from the actions themselves, and also how expected changes to the ungulate populations and park vegetation would affect park wildlife or wildlife habitat. The park's wildlife species are directly affected by the natural abundance, biodiversity, and the ecological integrity of the vegetation that composes their habitat.

Available information on known wildlife, including unique or important native wildlife and wildlife habitat, was compiled and analyzed in relation to the management actions. Impact intensity thresholds were defined for adverse impacts. For this plan/EIS, assignment of intensity levels for native wildlife and wildlife habitat impacts are based on the potential for changes to such characteristics as follows:

- Negligible:* There would be no observable or measurable impacts to native species, their habitats, or the natural processes sustaining them. Impacts would be well within natural fluctuations. Habitat would retain current ecological integrity to support wildlife species.
- Minor:* Impacts on native species, their habitats, or the natural processes sustaining them would be detectable. Small changes to population numbers, population structure, genetic variability, and other demographic factors might occur, but would not affect population viability or stability. Occasional responses to disturbance by some individual wildlife could be expected, but without interference to factors affecting population levels. Management actions would not negatively affect the viability and stability of native species and their associated habitat. Impacts would be outside critical reproduction periods for native species.
- Moderate:* Impacts on native species, their habitats, or the natural processes sustaining them would be detectable. Changes to population numbers, population structure, genetic variability, and other demographic factors would occur, but species viability and stability would not be negatively affected by management actions. Frequent responses to disturbance by some individual wildlife could be expected, with some impacts on factors affecting population levels possible. Habitat would retain adequate ecological integrity to support viability of all native species. Some impacts might occur during critical periods of reproduction or in key habitat for native species.
- Major:* Impacts on native species, their habitats, or the natural processes sustaining them would be detectable. Population numbers, population structure, genetic variability, and other demographic factors might experience large-scale changes that could affect population stability and viability. Frequent responses to disturbance by some individual wildlife would be expected, with resulting decreases in population levels. Loss of habitat might affect the viability of at least some native species. Impacts would regularly occur during critical periods of reproduction or in key habitat for native species.

## **IMPACTS OF THE ALTERNATIVES**

### **Alternative A: No Action (Continue Existing Non-native Ungulate Management Activities)**

#### **Analysis**

Native wildlife and wildlife habitat would be temporarily disturbed during implementation of management actions, including monitoring, fence construction and maintenance, and non-native ungulate removal efforts. The use of helicopters (for monitoring, direct reduction, or fence construction and maintenance) would introduce unnatural noise in the park, and would temporarily disrupt and potentially displace some native species. Any activities, including monitoring, that involve low-flying aircraft may affect the behavior and ecology of wildlife both during and after overflights. Altered behavior includes changes in movement patterns, foraging and breeding behavior, and energy expenditure (Tracey and Fleming 2006). However, aerial operations are temporary, and any disruption would end once a

management action is complete. The use of firearms, the presence of people associated with management actions, and the use of dogs would contribute to localized disturbance of wildlife during management actions. Firearm noise suppressors would be considered at the discretion of the park, and could reduce the disturbance to native wildlife. The short-term impacts would result from temporary actions, such as the use of firearms during ungulate removal and aerial operations, and construction and maintenance of fences, which would occur infrequently and would not result in lasting effects on native wildlife and wildlife habitat.

These impacts could occur during reproductive periods or in key habitat for native wildlife. However, the NPS takes certain steps to minimize the associated effects. For example, fence corridors are surveyed for sensitive plant and animal species prior to construction, repair, or replacement, and fence work is minimized or avoided in areas identified as sensitive bird or bat habitat during critical breeding seasons. In addition, the potential long-term adverse impacts of fencing would be mitigated by modifying fencing, as necessary, to minimize impacts on native wildlife (e.g., the use of vinyl strips or flagging to make fencing more visible to petrels and the removal of barbed wire in areas where Hawaiian hoary bats are a concern) and address any changes in technology (to ensure effectiveness and avoid fence breaching). Although individuals could be temporarily displaced during implementation, they would return after management actions are completed, and population stability and viability would not be negatively affected by management actions. Any trampling of plants during management actions would have similar impacts to other routine field work, and would not affect the integrity of wildlife habitat.

The removal and exclusion of non-native ungulates would substantially reduce the threats they pose to native wildlife and wildlife habitat, and would support ecosystem protection, including recovery and restoration of native plants and animals. Reduction of ungulate browsing would enhance forest regeneration, increasing the availability of food and cover for species that depend on ground-layer and understory vegetation for survival. Thus, reduction of ungulate browsing would help support population viability of these species, including ground- and/or shrub-nesting birds (e.g., ‘ōma‘o and nēnē), and native invertebrates (such as the Kamehameha butterfly, Blackburn’s blue, and Hawaiian darner). Habitat for non-native mosquitoes would be reduced, which would help protect native forest birds from avian malaria and avian pox (NPS 1999a; USGS 2005a). The number of wildlife species that would benefit from these changes would increase as the vegetation becomes more diverse and abundant with reduced browsing pressure. Increased forest regeneration would also improve habitat for other species that inhabit the upper canopy. Although the removal of ungulates could cause an increase in non-native plants and alter the fire regime in some areas of the park, the implementation of weed and fire management programs (see chapter 2) through existing plans, and weed sanitation protocols to prevent establishment of invasive species, would minimize the potential effects on native wildlife and wildlife habitat.

Removal of non-native ungulates and restoration of native vegetation cover would also help to counteract potential pressures of global climate change on native wildlife and wildlife habitat. As noted in the “Vegetation and the Role of Climate Change” section in chapter 3, changes in temperature and moisture regimes may result in dramatic shifts in habitat range for a number of native plant and animal species and vegetation types, as well as facilitating disease transmission (e.g., avian malaria) and the movement of invasive species (Atkinson and LaPointe 2009; EPA 1998; Giambelluca et al. 2008; Nadkarni and Solano 2002; Root et al. 2003). Management of non-native ungulates would remove a key stressor on native ecosystems, thereby increasing the capacity of native species to adapt to changes in climate (NPS 2010c). Restoration of fragmented plant communities would assist the local migration of species in response to climate change. Also, removing ungulates would reduce the disturbance-facilitated establishment of non-native weeds, and remove a mechanism for their dispersal.

In summary, alternative A would result in short-term minor to moderate adverse impacts to native wildlife and wildlife habitat through implementation of monitoring and management actions, including fence

construction and maintenance, aerial operations, and the use of firearms in the direct removal of non-native ungulates. In the older section of the park, long-term beneficial impacts to native wildlife and wildlife habitat would result from the continuation of animal exclusion in managed units. However, long-term beneficial impacts to native wildlife and wildlife habitat would be unlikely for Kahuku and areas currently unmanaged (e.g., portions of ‘Ōla‘a), for which no established population-level objective and fencing strategy has been identified. Also, the implementation of management tools and monitoring would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities. Because alternative A would not incorporate the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, it would be uncertain whether the NPS would progress through management phases, monitor, and apply management tools consistently over time.

### **Cumulative Impacts**

Other past, present, and reasonably foreseeable future actions in and around the park have affected or could affect native wildlife and wildlife habitat. Past actions parkwide include development of facilities (e.g., water reservoirs, building and road improvements); maintenance of landscaped areas, including cultural landscapes (e.g., historic gardens and lawns); and the management of cultural resources, including historic properties. Although management plans ensure protection of native wildlife and wildlife habitat, future activities associated with the development and maintenance of facilities (grading, filling, construction, and inventory) at the park, including trails and roads, could contribute to localized short-term and long-term negligible to minor adverse impacts on native wildlife and wildlife habitat. Visitation at the park could also contribute to localized disturbances to native wildlife and wildlife habitat if visitors encounter any wildlife or damage habitat by wandering off designated trails. In Kahuku, past actions including agricultural operations (including grazing) and logging have resulted in large-scale land clearing and habitat fragmentation, contributing to short- and long-term moderate adverse impacts on native wildlife and wildlife habitat, particularly in lower-elevation areas (less than 5,000 feet elevation (1,524 meters)). Past actions adjacent to the park include increased land clearing due to urbanization, agriculture, and logging. Grazing and urbanization adjacent to the park continues today, resulting in land clearing and habitat loss. Land clearing, grazing, and adjacent urbanization in the future would continue to adversely impact native wildlife and wildlife habitat.

Since 1983, the number of commercial airplanes and helicopters flying over the park has increased dramatically, and are a substantial source of unnatural sounds in the park (Lawson et al. 2007). Other aviation activities over the park and surrounding areas include general aviation, commercial passenger flights, park administrative actions that include fire and emergency operations as well as resource protection. In response, the park is working with the FAA to develop an ATMP and EIS to determine effective measures to mitigate or prevent adverse impacts, if any, of commercial air tour operations on the park’s natural resources, including native wildlife and wildlife habitat. The implementation of an ATMP at the park would result in long-term benefits for native wildlife and wildlife habitat because measures would be established to prevent adverse impacts on the park’s natural resources from commercial air tour operations.

Changes in the fire regime due to habitat fragmentation and non-native species pose a threat to native wildlife and wildlife habitat as well. Particularly in dry and seasonally dry ecosystems, fire is promoted by non-native plants and many non-native species recover quickly after fire, suppressing native species recovery (Tunison et al. 2001). In addition, increased human-caused fires contribute to direct loss of native plant species, leading to habitat fragmentation. However, the park’s fire management plan (NPS 2005a) outlines procedures and approaches for the monitoring and suppression of wildfires, mitigation measures to reduce the chance of wildfire, and maintenance and restoration of natural resources, resulting in long-term benefits for native wildlife and wildlife habitat. The NPS and Big Island Wildfire

Coordinating Group have cosponsored community wildfire protection plans, which have been developed by local communities in the vicinity of the park, outlining mitigation measures to reduce the chances of wildfires occurring in these communities (Laitinen 2006a, 2006b).

Many past, current, and future actions, plans, and programs at the park and in surrounding areas provide benefits for native wildlife and wildlife habitat. Past park actions such as fencing to exclude non-native ungulates have resulted in native vegetation and habitat recovery (these fencing efforts are discussed in chapter 1 and as an element common to all alternatives in chapter 2). The park's current weed management program, which includes monitoring and removal of incipient weeds, will address new weeds that may enter the park and contain the spread of highly invasive weeds into high-priority wildlife habitat. The acquisition of the Kahuku Unit resulted in increased protection of native wildlife and wildlife habitat due to implementing management actions under the interim operating plan that were not previously being implemented. During the last 20 years, members of the TMA have constructed fences, excluded non-native ungulates, controlled weeds, and planted native vegetation in several areas adjacent or near the park. These actions have resulted in the recovery of native wildlife habitat. Natural resource and watershed protection in lands in and adjacent to the park has previously supported and will continue to support the protection and restoration of native wildlife species and their habitat. The future implementation of the GMP for the park will also involve prescriptions for desired conditions related to natural resources balanced with those for visitor use. Areas adjacent to the park that are not managed for the conservation of native wildlife will likely continue to degrade due to the uncontained spread of non-native plant species and ongoing impacts caused by non-native ungulates.

Additional actions providing benefits for native wildlife and wildlife habitat include park educational programs and interpretation activities, the implementation of USFWS recovery plans for sensitive species, implementation of the *Ala Kahakai National Historic Trail Management Plan*, and revegetation and sensitive species restoration activities. The overriding goal of these restoration plans is the perpetuation of native ecosystems and the recovery of biological diversity in the park. For rare or listed bird species and invertebrates, recovery efforts focus on habitat restoration through management of non-native plants and non-native animals.

Some past, current, and future actions contribute to both beneficial and adverse impacts, depending on what stage of implementation they are in. For example, construction and maintenance of fences in the park would contribute to localized minor adverse impacts while the fences are being erected (due to unnatural noise and habitat disruption from fence construction), but would also contribute to beneficial impacts once the fences are erected by keeping non-native ungulates out of certain areas. Likewise, law enforcement activities would contribute to beneficial impacts by protecting native wildlife and wildlife habitat from being disrupted or degraded by visitors, but it would also contribute to localized minor adverse impacts if law enforcement staff members disturb the wildlife themselves.

Although short- and long-term minor to moderate adverse impacts would result from past, present, and future human activities on the landscape (inside and outside the park), there would also be long-term beneficial impacts to native wildlife and wildlife habitat. When combined with the short-term minor to moderate adverse impacts under alternative A, there would be short- and long-term minor to moderate adverse cumulative impacts on native wildlife and wildlife habitat. Long-term beneficial cumulative impacts would be less likely under alternative A, because non-native ungulate management within the park would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

## **Conclusion**

Under alternative A, short-term minor to moderate adverse impacts would result from the implementation of monitoring and management actions. In the older section of the park, long-term beneficial impacts to native wildlife and wildlife habitat would result from the continuation of animal exclusion in managed units. However, long-term beneficial impacts to native wildlife and wildlife habitat would be unlikely for Kahuku and areas currently unmanaged (e.g., portions of Kahuku and ‘Ōla‘a), for which no established population-level objective and fencing strategy has been identified. The effects of alternative A, when combined with impacts of past, present, and reasonably foreseeable future actions on native wildlife and wildlife habitat, would have short- and long-term minor to moderate adverse cumulative impacts on vegetation. Long-term beneficial cumulative impacts would be less likely under alternative A, because management would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

## **Alternative B: Comprehensive Management Plan that Uses Lethal Removal Techniques**

### **Analysis**

The removal of non-native ungulates from the park would result in long-term benefits to native wildlife and wildlife habitat from reduced browsing pressure, as well as from ecosystem restoration and recovery. Habitat for non-native mosquitoes would be reduced, which would help protect native forest birds from avian malaria and avian pox (NPS 1999a; USGS 2005a). The number of wildlife species that would benefit from these changes would increase as the vegetation becomes more diverse and abundant with reduced browsing pressure. Long-term beneficial impacts to native wildlife and wildlife habitat would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

Native wildlife and wildlife habitat would be temporarily disturbed during implementation of management actions, including monitoring, fence construction and maintenance, and non-native ungulate removal efforts. Low-flying aircraft, may temporarily affect the behavior and ecology of wildlife. However, helicopter activities are temporary, and any disruption would end once a management action is complete. The use of firearms, the presence of people associated with management actions, and the use of dogs would contribute to localized disturbance of wildlife during management actions. Firearm noise suppressors would be considered at the discretion of the park, and could reduce the disturbance to native wildlife. The short-term impacts would result from temporary actions, such as the use of firearms during ungulate removal and aerial operations, and construction and maintenance of fences, which would occur infrequently and would not result in lasting effects on native wildlife and wildlife habitat.

The NPS would take steps to minimize adverse effects associated with this alternative. For example, fence corridors are surveyed for sensitive plant and animal species prior to construction, repair, or replacement, and fence work is minimized or avoided in areas identified as sensitive bird or bat habitat during critical breeding seasons. In addition, the potential long-term adverse impacts of fencing would be mitigated by modifying fencing, as necessary, to minimize impacts on native wildlife (e.g., the use of vinyl strips or flagging to make fencing more visible to petrels and the removal of barbed wire in areas where Hawaiian hoary bats are a concern) and address any changes in technology (to ensure effectiveness and avoid fence breaching). Although individuals could be temporarily displaced during implementation, they would return after management actions are completed, and population stability and viability would

not be negatively affected by management actions. Any trampling of plants during management actions would have similar impacts to other routine field work, and would not affect the integrity of wildlife habitat.

Although the removal of ungulates could cause an increase in non-native plants and alter the fire regime in the park, the implementation of weed and fire management programs (see chapter 2) through existing plans, and weed sanitation protocols to prevent establishment of invasive species, would minimize the potential effects on native wildlife and wildlife habitat.

Additionally, removal of non-native ungulates and restoration of native vegetation would help to counteract potential pressures of global climate change on native wildlife and wildlife habitat by removing a key stressor on native ecosystems, thereby increasing the capacity of native species to adapt to changes in climate (NPS 2010c).

In summary, alternative B would result in short-term minor to moderate adverse impacts to native wildlife and wildlife habitat through implementation of monitoring and management actions, including fence construction and maintenance, aerial operations, and the use of firearms in the direct removal of non-native ungulates. Long-term beneficial impacts to native wildlife and wildlife habitat would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative B would be the same as alternative A. The short- and long-term minor to moderate adverse and long-term beneficial impacts of past, present, and future actions, when combined with the impacts of implementing alternative B, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts on wildlife and wildlife habitat. Under alternative B, long-term beneficial impacts would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Conclusion**

Under alternative B, short-term minor to moderate adverse impacts would result from the implementation of monitoring and management actions. Long-term beneficial impacts to native wildlife and wildlife habitat would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time. The effects of alternative B, when combined with impacts of past, present, and reasonably foreseeable future actions on wildlife and wildlife habitat, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

### **Alternative C: Comprehensive Management Plan that Maximizes Efficiency by Expanding Lethal Removal Techniques and Discontinuing the Use of Volunteers**

#### **Analysis**

Similar to alternative B, alternative C would result in short-term minor to moderate adverse impacts on native wildlife and wildlife habitat through implementation of management actions, including monitoring, fence construction and maintenance, and non-native ungulate removal efforts. Long-term beneficial impacts to native wildlife and wildlife habitat would be fully realized under this alternative.

Because lethal techniques would be expanded and enhanced, and volunteers would not be used during direct reduction efforts under alternative C, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative B. The increased efficiency associated with discontinuing the use of volunteers is based on additional work required by NPS staff to recruit, administer, train and direct volunteers in the field, and data that show that park staff remove more ungulates per day when they conduct direct reduction (ground shooting) themselves, compared to when they are accompanied by volunteers (Stephens et al. 2008). Therefore, fewer reduction activities would result when compared to alternative B.

#### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative C would be the same as alternative A. Similar to alternative B, the short- and long-term minor to moderate adverse and long-term beneficial impacts of past, present, and future actions, when combined with the impacts of implementing alternative C, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts on wildlife and wildlife habitat.

#### **Conclusion**

Under alternative C, short-term minor to moderate adverse impacts would result from the implementation of monitoring and management actions. Long-term beneficial impacts would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative C than under alternative B. The effects of alternative C, when combined with impacts of past, present, and reasonably foreseeable future actions on wildlife and wildlife habitat, would have long-term beneficial and short- and long-term minor to moderate adverse cumulative impacts.

### **Alternative D: Comprehensive Management Plan that Maximizes Flexibility of Management Techniques**

#### **Analysis**

Similar to alternative B, alternative D would result in short-term minor to moderate adverse impacts on native wildlife and wildlife habitat through implementation of management actions, including monitoring, fence construction and maintenance, and non-native ungulate removal efforts. Long-term beneficial impacts to native wildlife and wildlife habitat would be fully realized under this alternative.

Under alternative D, it is possible that increased human and vehicular traffic associated with potential relocation activities could cause additional native wildlife and wildlife habitat disturbance during the process of driving animals to adjacent lands. However, these impacts would be short-term and localized, and similar to impacts of other management actions.

Although the expansion and enhancement of lethal removal techniques under alternative D would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the continued use of volunteers and the expansion of non-lethal techniques would counteract this to some extent. Inclusion of non-lethal removal would require additional staff time and park resources to relocate animals to adjacent lands, and may increase the time associated with reduction actions over the life of the plan, as well as time needed to reach the post-reduction phase. As a result, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative D would be the same as alternative A. Similar to alternative B, the short- and long-term minor to moderate adverse and long-term beneficial impacts of past, present, and future actions, when combined with the impacts of implementing alternative D, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts on wildlife and wildlife habitat.

### **Conclusion**

Under alternative D, short-term minor to moderate adverse impacts would result from the implementation of monitoring and management actions. Long-term beneficial impacts would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly under alternative D than under alternative C. The effects of alternative D, when combined with impacts of past, present, and reasonably foreseeable future actions on wildlife and wildlife habitat, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

## **Alternative E: Comprehensive Management Plan that Increases Flexibility of Management Techniques While Limiting the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative E would result in short-term minor to moderate adverse impacts on native wildlife and wildlife habitat through implementation of management actions, including monitoring, fence construction and maintenance, and non-native ungulate removal efforts. Long-term beneficial impacts to native wildlife and wildlife habitat would be fully realized under this alternative.

Similar to alternative D, it is possible that potential relocation activities could cause additional native wildlife and wildlife habitat disturbance during the process of driving animals to adjacent lands under alternative E.

Although the expansion and enhancement of lethal removal techniques under alternative E would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the expansion of non-lethal techniques would counteract this to some extent. However, because volunteers would not be used during direct reduction efforts under alternative E, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative D, but less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative E would be the same as alternative A. Similar to alternative B, long-term beneficial impacts would be fully realized under this alternative. The short- and long-term minor to moderate adverse and long-term beneficial impacts of past, present, and future actions, when combined with the impacts of implementing alternative E, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts on vegetation.

### **Conclusion**

Under alternative E, short-term minor adverse impacts would result from the implementation of monitoring and management actions. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative E than under alternative D, but less quickly than under alternative C. The effects of alternative E when combined with impacts of past, present, and reasonably foreseeable future actions on wildlife and wildlife habitat, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

## **RARE, UNIQUE, THREATENED, OR ENDANGERED SPECIES**

### **GUIDING REGULATIONS AND POLICIES**

The ESA (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 USFWS 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 2006b). The NPS is required to control access to important habitat for such species and to perpetuate their natural distribution and abundance and the ecosystems upon which they depend. NPS *Management Policies 2006* states that “[the NPS will] manage state and locally listed species in a manner similar to its treatment of federally listed species to the greatest extent possible” (NPS 2006b, Section 4.4.2.3).

The park's natural resources management plan (NPS 1974) includes the following actions that pertain to rare, unique, or federally listed species:

- Propagating rare and endangered plant and animal species
- Reintroducing rare species into former range
- Protecting rare, endemic biota from depredation by introduced species
- Reducing feral ungulate numbers to allow endangered plants to survive and become reestablished (NPS 1974).

The park is further directed by their statement for management to “protect the park's remnant Hawaiian ecosystems, including endangered species, from further depredation and competition by those non-native animals and plants introduced by modern people” (NPS 1985).

The park provides habitat for 37 plants and 18 animals (including birds, insects, mammals, and reptiles) listed as threatened, endangered, or candidate species (see table 7 in chapter 3). These include species that historically have been found in or adjacent to the park but are no longer present (e.g., kīponaona, ‘ō‘ū), non-resident species (e.g., Hawaiian monk seal and honu [green turtle]) and outplanted individuals derived from species located outside the park (e.g., koki‘o).

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*The park provides habitat for 37 plants and 18 animals (including birds, insects, mammals, and reptiles) listed as threatened, endangered, or candidate species.*

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## METHODOLOGY, ASSUMPTIONS, AND IMPACT THRESHOLDS

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 information contained in chapter 1 and chapter 3.

The analysis for alternative A was organized to present a general discussion of the impacts that would occur on rare, unique, threatened, or endangered plants and animals. This is followed by a more detailed analysis of how these impacts would affect these species, including wildlife and plants. The analyses for subsequent alternatives build off this approach.

The following thresholds were used to determine impacts on rare, unique, threatened, or endangered species.

### Federally Listed Species

The following thresholds were used to determine the magnitude of effects on federally listed special-status species and their associated habitat, including designated critical habitat that would result from implementation of any of the alternatives.

#### Adverse

*Negligible:* There would be no observable or measurable impacts on federally listed species, their habitats, or the natural processes sustaining them in the proposed project area.

*Minor:* Individuals may temporarily avoid areas. Impacts would not affect critical periods (e.g., breeding, nesting, denning, feeding, or resting) or habitat.

*Moderate:* Individuals may be impacted by disturbances that interfere with critical periods (e.g., breeding, nesting, denning, feeding, or resting) or habitat; however, the level of impact would not result in a physical injury, mortality, or extirpation from the park.

*Major:* Individuals may suffer physical injury or mortality or populations may be extirpated from the park.

### **Beneficial**

*Negligible:* There would be no observable or measurable impacts on federally listed species; their habitats, including critical habitat designated under the ESA; or the natural processes sustaining them in a park site.

*Minor:* Impacts would result in slight increases to viability of the species in the park as species-limiting factors (e.g., habitat loss, competition, and mortality) are kept in check. Nonessential features of critical habitat in a park site would be slightly improved.

*Moderate:* Impacts would result in improved viability of the species, population structure, and species population levels in the park, as species-limiting factors (e.g., habitat loss, competition, and mortality) are reduced. Some essential features of critical habitat would be improved.

*Major:* Impacts would result in highly noticeable improvements to species viability, population structure, and species population levels in the park, as species-limiting factors (e.g., habitat loss, competition, and mortality) are nearly eliminated. All essential features of the critical habitat would be improved.

### **Species of Special Concern**

The assessment of adverse impacts on both plant and animal species identified as species of special concern (but not listed at the federal level under the ESA) uses the same thresholds developed for the assessment of impacts on wildlife and wildlife habitat, as follows:

*Negligible:* There would be no observable or measurable impacts on native species, their habitats, or the natural processes sustaining them. Impacts would be well within natural fluctuations. Habitat would retain current ecological integrity to support native species.

*Minor:* Impacts on native species, their habitats, or the natural processes sustaining them would be detectable. Small changes in population numbers, population structure, genetic variability, and other demographic factors might occur, but would not affect population viability or stability. Occasional responses to disturbance by some individuals could be expected, but without interference to factors affecting population levels. Habitat would retain adequate ecological integrity to support viability of all native species. Impacts would be outside critical reproduction periods for native species.

*Moderate:* Impacts on native species, their habitats, or the natural processes sustaining them would be detectable. Changes in population numbers, population structure, genetic variability, and other demographic factors would occur, but species would remain stable and viable. Frequent responses to disturbance by some individuals could be expected, with some impacts on factors affecting population levels possible. Habitat would retain adequate ecological integrity to support viability of all native species. Some impacts might occur during critical periods of reproduction or in key habitat for native species.

*Major:* Impacts on native species, their habitats, or the natural processes sustaining them would be detectable. Population numbers, population structure, genetic variability, and other demographic factors might experience large-scale changes that could affect population stability and viability. Frequent responses to disturbance by some individuals would be expected, with resulting decreases in population levels. Loss of habitat might affect the viability of at least some native species. Impacts would regularly occur during critical periods of reproduction or in key habitat for native species.

## IMPACTS OF THE ALTERNATIVES

### Alternative A: No Action (Continue Existing Non-native Ungulate Management Activities)

#### Analysis

Rare, unique, threatened, or endangered species would be temporarily disturbed during implementation of management actions, including monitoring, fence construction and maintenance, and non-native ungulate removal efforts. The use of helicopters (for monitoring, direct reduction, or fence construction and maintenance) would introduce unnatural noise into the park and would temporarily disrupt and potentially displace some sensitive wildlife species. Any activities, including monitoring, that involve low-flying aircraft may affect the behavior and ecology of sensitive wildlife both during and after overflights. Altered behavior includes changes in movement patterns, foraging and breeding behavior, and energy expenditure (Tracey and Fleming 2006).

Similar disturbances to sensitive wildlife would occur from the use of firearms, the use of equipment for fencing (e.g., post drivers and rock drills), and the presence of people associated with ground-based management actions. Such actions include direct reduction with firearms, which can include the use of trained dogs; the setting of traps, snares, and bait stations; fence construction and repairs; and monitoring. Ground-based management actions would also have impacts on sensitive vegetation that would occur during routine field activities (e.g., trampling from foot traffic, vegetation clearing for fence corridors). Implementation of management actions would result in minor to moderate adverse impacts to rare, unique, threatened, or endangered species from displacement and disruption caused by habitat disturbance and unnatural noise. However, as described in chapter 2, all operations are intermittent and temporary, with fewer actions in ungulate free areas than in areas where animals remain (e.g., Kahuku, portions of ‘Ōla‘a). Although individuals could be temporarily displaced during implementation, they would return after management actions are completed, and population stability and viability would not be negatively affected by management actions. The duration and frequency of these actions would also decrease as the park moves from reduction into less intensive management phases.

These impacts could occur during reproductive periods or in key habitat for rare, unique, threatened, or endangered species. However, the park also takes certain steps to minimize the associated effects of non-native ungulate management actions, leading to long-term benefits for rare, unique, threatened, or endangered species. For example, fence corridors are surveyed for sensitive plant and animal species prior to construction, repair, or replacement, and fence work is minimized or avoided in areas identified as sensitive bird or bat habitat during critical breeding seasons. In addition, the potential long-term adverse impacts of fencing would be mitigated by modifying fencing, as necessary, to minimize impacts on native wildlife (e.g., the use of vinyl strips or flagging to make fencing more visible to petrels and avoiding the use of barbed wire in areas where Hawaiian hoary bats are a concern per comments received from USFWS) and address any changes in technology (to ensure effectiveness and avoid fence breaching). Firearm noise suppressors would be considered at the discretion of the park, and could reduce the disturbance to rare, unique, threatened, or endangered wildlife species. While foot traffic has the potential to affect individual plants, it would not appreciably affect their habitat, population levels, or the ability to support other sensitive species.

The removal and exclusion of non-native ungulates would substantially reduce the threats they pose to sensitive species and habitat, and would support ecosystem protection, including recovery and restoration of native plants and animals. Reduction of ungulate browsing would enhance forest regeneration, increasing the availability of food and cover for species that depend on ground-layer and understory vegetation for survival. Thus, reduction of ungulate browsing would help support the population viability of these species, including ground- and/or shrub-nesting birds (e.g., nēnē and ōma‘o) and native invertebrates in the park. Habitat for non-native mosquitoes would be reduced, which would help protect vulnerable forest birds. The number of wildlife species that would benefit from these changes would increase as the vegetation becomes more diverse and abundant with reduced browsing pressure.

In addition to protecting and restoring rare, unique, threatened, or endangered species and their habitat, removal of non-native ungulates and restoration of native vegetation cover could also help counteract potential pressures of global climate change on sensitive plant and animal species. As noted in the “Vegetation and the Role of Climate Change” section of chapter 3, changes in temperature and moisture regimes may result in dramatic shifts in habitat range for a number of sensitive plant and animal species, facilitating disease transmission (e.g., avian malaria) and the movement of invasive species (Atkinson and LaPointe 2009; EPA 1998; Giambelluca et al. 2008; Nadkarni and Solano 2002; Root et al. 2003). Management of non-native ungulates will remove a key stressor on native ecosystems, thereby increasing the capacity of native species to adapt to changes in climate (NPS 2010c). Restoration of fragmented plant communities will assist the local migration of species in response to climate change. In addition, removing ungulates will reduce the disturbance-facilitated establishment of non-native plants and remove a mechanism for their dispersal.

**Invertebrates.** As described in chapter 3, there are three federally listed invertebrate species historically known in the park, as well as one candidate species: the damselfly *Megalagrion nesiotes* (endangered), pomace fly *Drosophila heteroneura* (endangered), *D. mulli* (threatened), and *D. digressa* (candidate). Although they have occurred historically, it is unknown whether these federally listed and candidate species currently occur in the park. However, habitat and host plants for these species do occur in the park, including designated critical habitat for *D. heteroneura* (687 acres of the total 4,582 acres designated on the island) (USFWS 2008b). The remaining invertebrate species are considered rare or sensitive, and are known to currently occur in the park (see table 8 in chapter 3).

Management actions are not expected to affect individual invertebrates. Any impacts on host plants or habitat would be limited to potential effects from foot traffic associated with ground-based management actions and vegetation clearing for fence corridors, as well as from fence construction. While foot traffic has the potential to affect individual host plants, it would not appreciably affect their habitat, population

levels, or their ability to support these sensitive species. Vegetation clearing for fencing would be limited to a four-foot wide corridor and avoid removing important host plants for listed species (see the “Elements Common to All Action Alternatives” section in chapter 2).

Exclusion of ungulates would support recovery of native host plants and critical habitat, which would assist in the recovery of rare invertebrates. Certain species of ‘ōhā (*Clermontia* spp.), one of the primary host plants of *Drosophila heteroneura*, are known to be palatable and vulnerable to feral pigs and are considered to be indicators of pig damage in Hawai‘i (Pratt et al. 1999). Fencing and pig control have already been implemented in the ‘Ōla‘a Forest to provide protection to host plants of *D. mulli*. Due to the small population size of *D. digressa* and its small habitat area, this species and its habitat are particularly vulnerable to the effects of ungulates, which destroy host plants and habitat by trampling plants, facilitating erosion, and spreading non-native plant seeds (USFWS 2008b).

In summary, alternative A would result in short-term negligible adverse effects on invertebrates, including the federally listed *Drosophila heteroneura* and *Megalagrion nesiotis*, through implementation of management actions. In the older section of the park, long-term beneficial effects to native host plants and critical habitat, including moderate to major beneficial effects for federally listed species, would result through the continuation of animal exclusion in managed units. However, long-term beneficial impacts would be unlikely for Kahuku and currently unmanaged areas (e.g., portions of ‘Ōla‘a), for which no established population-level objective and fencing strategy has been identified. Also, the implementation of management tools and monitoring would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities. Because alternative A would not incorporate the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, it would be uncertain whether the NPS would progress through management phases, monitor, and apply management tools consistently as staff and institutional knowledge change over time.

**Mammals.** The federally endangered Hawaiian hoary bat is widely distributed in the park between sea level and 7,500 feet (2,286 meters), with breeding primarily occurring at lower elevations. Under alternative A, temporary disruption of Hawaiian hoary bat habitat and behavior, as well as displacement, may result from implementation of management actions. However, steps would be taken to minimize impacts of actions such as avoiding the use of barbwire for construction of fencing (see chapter 2). As a result, management actions would have short-term minor to moderate adverse impacts on the Hawaiian hoary bat.

Much remains to be known about the roosting habitat, food requirements, and threats to the Hawaiian hoary bat before specific management actions can be identified (USFWS 1998b). Island-wide acoustic monitoring has identified the highest recorded bat densities in native-dominated forest, which suggests there may be some direct benefit to be gained for the bat by protecting and restoring native forest (Bonaccorso, pers. comm.). In the older section of the park, this may result in long-term minor to moderate beneficial effects on the Hawaiian hoary bat through the continuation of animal exclusion in managed units. However, long-term beneficial impacts would be unlikely for Kahuku and areas currently unmanaged (e.g., portions of ‘Ōla‘a), for which no established population-level objective and fencing strategy has been identified. Also, the implementation of management tools and monitoring would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities. Because alternative A would not incorporate the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, it would be uncertain whether the NPS would progress through management phases, monitor, and apply management tools consistently as staff and institutional knowledge change over time.

**Birds.** As described in chapter 3, federally listed bird species found in the park include nēnē, ‘io (Hawaiian hawk), ‘akiapōlā‘au, ‘ākepa, Hawai‘i creeper, ‘ō‘ū, ‘u‘au (Hawaiian petrel), and ‘a‘o (Newell’s shearwater). Other species found in the park include ‘akē ‘akē (band-rumped storm petrel), a candidate and state listed species, and several rare or sensitive species, including ‘i‘iwi, noio (black noddy), ‘ou (Bulwer’s petrel), and koa‘e-kea (white-tailed tropicbird).

As stated earlier in the discussion of “Impacts on Rare, Unique, Threatened, or Endangered Species,” actions under alternative A could temporarily disrupt native habitat or behavior of sensitive bird species in the park. Ground-based management actions could disrupt sensitive bird species, especially those that depend on ground-layer and understory vegetation. The unnatural noise and disturbance associated with helicopters, firearms, and fence construction could affect all birds, including those that nest in the upper canopy and higher above the ground. These actions would have little effect on birds that nest along the coast or on offshore islets, such as, noio, and ‘ou, as management actions are limited in these areas. Individual birds could be temporarily displaced during implementation of management actions, but would return after management actions are completed, and population stability and viability would not be negatively affected by management actions. While foot traffic has the potential to affect individual plants, it would not appreciably affect habitat for sensitive birds or their population levels. Trained dogs to assist with ground control efforts would not be used in known breeding/molting areas of the nēnē, and consultation with the nēnē biologist would be required prior to deployment in potential habitat.

There could be some long-term impacts for rare, unique, threatened, or endangered birds caused by fencing. Fence strikes are a concern for seabirds that use upland habitats (e.g., petrels), but fencing would be modified, as necessary, to minimize impacts on native wildlife (e.g., the use of vinyl strips or flagging to make fencing more visible to petrels) and address any changes in technology (to ensure effectiveness and avoid fence breaching).

The removal and exclusion of non-native ungulates would substantially reduce threats to sensitive bird species and maintain or restore habitat, including forest tree regeneration. Reduction of ungulate browsing would increase the availability of food and cover for species that depend on ground-layer and understory vegetation for survival. Increased forest regeneration would also improve habitat for other species that inhabit and feed in the upper canopy. Thus, reduction of ungulate browsing would help support population viability of these species, including ground- and/or shrub-nesting birds (e.g., ‘ōma‘o and nēnē). Habitat for non-native mosquitoes would be reduced, which would help protect native forest birds from avian malaria and avian pox (NPS 1999a; USGS 2005a). The number of wildlife species that would benefit from these changes would increase as the vegetation becomes more diverse and abundant with reduced browsing pressure and additional planting of species. Although the removal of ungulates could cause an increase in non-native plants and alter the fire regime in some areas of the park, the implementation of weed and fire management programs (see chapter 2) through existing plans would minimize the potential effects on sensitive bird species and their habitat.

In summary, alternative A would result in minor to moderate short-term and minor long-term adverse effects through implementation of non-native ungulate management activities (noted above). In the older section of the park, long-term beneficial effects on rare, unique, threatened, or endangered birds would occur, with moderate to major beneficial impacts on federally listed birds (e.g., nēnē, ‘io, ‘a‘o, ‘u‘au), through the continuation of animal exclusion in managed units. However, long-term beneficial impacts would be unlikely for Kahuku and areas currently unmanaged (e.g., portions of ‘Ōla‘a), for which no established population-level objective and fencing strategy has been identified. Also, the implementation of management tools and monitoring would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities. Because alternative A would not incorporate the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, it would be uncertain whether the NPS would

progress through management phases, monitor, and apply management tools consistently as staff and institutional knowledge change over time.

**Plants.** There are a number of federally listed plant species found in the park and surrounding areas (see table 7 in chapter 3). Some of these species have designated critical habitat in the park, including Mauna Loa silversword, *Cyrtandra giffardii*, Hilo ischaemum, laukahi kuahiwi, po‘e, hau kuahiwi, Zahlbruckner’s pelea, Hawai‘i hala pepe, ‘ōhai, sheriff’s catchfly, and white-bur cucumber. Additional plant species are considered rare or species of concern, including several that are candidates for listing under the ESA (see tables 7 and 8 in chapter 3).

As previously described under this alternative, impacts on rare, unique, threatened, or endangered plant species could occur from temporary actions associated with ground-based management actions, which would be limited to trampling from associated foot traffic and vegetation clearing for fence placement. However, impacts from fencing would be mitigated by surveying fence corridors and adjusting fence alignments to avoid impacting sensitive plants prior to construction, repair, or replacement.

The exclusion and removal of non-native ungulates would eliminate a source of mortality for sensitive plants and a vector for non-native species dispersal. Animal removal would support recovery and restoration of plant populations and their habitat, including critical habitat for some federally listed plant species. Although the removal of ungulates could cause an increase in non-native plants and alter the fire regime in some areas of the park, the implementation of weed and fire management programs (see chapter 2) through existing plans would minimize the potential effects on sensitive plant species and their habitat.

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In summary, alternative A would result in minor to moderate short-term and minor long-term adverse effects through implementation of non-native ungulate management activities (noted above). In the older section of the park, long-term beneficial effects on rare, unique, threatened, or endangered plants would occur, with moderate to major beneficial impacts on federally listed plants, through the continuation of animal exclusion in managed units. However, long-term beneficial impacts would be unlikely for Kahuku and areas currently unmanaged (e.g., portions of ‘Ōla‘a), for which no established population-level objective and fencing strategy has been identified. Also, the implementation of management tools and monitoring would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities. Because alternative A would not incorporate the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, it would be uncertain whether the NPS would progress through management phases, monitor, and apply management tools consistently as staff and institutional knowledge change over time.

### **Cumulative Impacts**

Other past, present, and reasonably foreseeable future actions in and around the park have affected or could affect rare, unique, threatened, or endangered species. Past actions parkwide include development of facilities (e.g., water reservoirs, building and road improvements); maintenance of landscaped areas, including cultural landscapes (e.g., historic gardens and lawns); and the management of cultural resources, including historic properties. Although management plans ensure protection of sensitive species and native habitat, future activities associated with the development and maintenance of facilities

(grading, filling, construction, and inventory) at the park, including trails and roads, could contribute to localized short-term and long-term negligible to minor adverse impacts on rare, unique, threatened, or endangered species. Visitation at the park could also contribute to localized disturbances to rare, unique, threatened, or endangered species and their habitat if visitors encounter any species of special concern or damage habitat by wandering off designated trails. In Kahuku, past actions including agricultural operations (including grazing) and logging have resulted in large-scale land clearing and habitat fragmentation, contributing to short- and long-term moderate adverse impacts on rare, unique, threatened, or endangered species, particularly at lower elevations (<5,000 feet elevation (<1,524 meters)). Past actions adjacent to the park include increased land clearing due to urbanization, agriculture, and logging. Grazing and urbanization adjacent to the park continues today, resulting in land clearing and habitat loss. Land clearing, grazing, and adjacent urbanization in the future would continue to adversely impact rare, unique, threatened, or endangered species.

Changes in the fire regime due to habitat fragmentation and non-native species pose a threat to rare, unique, threatened, or endangered species. Particularly in dry and seasonally dry ecosystems, fire is promoted by non-native plants and many non-native species recover quickly after fire, suppressing native species' recovery (Tunison et al. 2001). In addition, increased human-caused fires contribute to direct loss of sensitive plant species, leading to habitat fragmentation. However, the park's fire management plan (NPS 2005a) outlines procedures and approaches for the monitoring and suppression of wildfires, mitigation measures to reduce the chance of wildfire, and maintenance and restoration of natural resources, resulting in long-term benefits for rare, unique, threatened, or endangered species, with minor to moderate beneficial impacts on federally listed species. The NPS and Big Island Wildfire Coordinating Group have cosponsored community wildfire protection plans, which have been developed by local communities in the vicinity of the park, outlining mitigation measures to reduce the chances of wildfires occurring in neighboring areas (Laitinen 2006a, 2006b).

Since 1983, the number of airplanes and helicopters flying over the park has increased dramatically, and are a substantial source of unnatural sounds in the park (Lawson et al. 2007). Other aviation activities over the park and surrounding areas include general aviation, commercial passenger flights, park maintenance, and fire and emergency operations. In response, the park is working with the FAA to develop an ATMP and EIS to determine effective measures to mitigate or prevent adverse impacts, if any, from commercial air tour operations on the park's natural resources, including rare, unique, threatened, or endangered species. Because measures would be established to protect the park's natural resources from the potential adverse effects of commercial air tour operations, the implementation of an ATMP at the park would result in long-term benefits for rare, unique, threatened, or endangered animal species.

Many past, current, and future actions, plans, and programs at the park and in surrounding areas provide benefits for rare, unique, threatened, and endangered species. Past actions such as fencing to exclude non-native ungulates have resulted in native vegetation and habitat recovery, which has aided in recovery of rare, unique, threatened and endangered species. The park's current weed management program, which includes monitoring and removal of incipient weeds, will address new non-native plants that may enter the park and will contain the spread of highly invasive non-native plants into high-priority wildlife habitat. The acquisition of the Kahuku Unit has resulted in increased protection of natural resources (including wildlife habitat) on these lands due to implementing management actions under the interim operating plan that were previously not being implemented. During the last 20 years, members of the TMA have constructed fences, excluded non-native ungulates, controlled weeds, and planted native vegetation in several areas adjacent or near the park. These actions have resulted in long-term benefits for rare, unique, threatened, and endangered species through the recovery of native vegetation and habitat. Natural resource and watershed protection on lands in and adjacent to the park has previously supported and will continue to support the protection and restoration of rare, unique, threatened, or endangered species. The future implementation of the GMP for the park will also involve prescriptions for desired

conditions related to the protection of natural resources, including rare, unique, threatened, or endangered species, balanced with those for visitor use. Areas adjacent to the park that are not managed for the conservation of native vegetation and wildlife habitat will likely continue to degrade due to the uncontained spread of invasive plant species and ongoing impacts caused by non-native ungulates.

Additional actions providing benefits for rare, unique, threatened, or endangered species include park educational programs and interpretation activities, the implementation of USFWS recovery plans for sensitive species, implementation of the *Ala Kahakai National Historic Trail Management Plan*, and revegetation and sensitive species restoration activities. The overriding goal of these restoration plans is the perpetuation of native ecosystems and the recovery of biological diversity in the park. For rare or listed bird species and invertebrates, recovery efforts focus on habitat restoration through management of non-native plants and non-native animals.

Some past, current, and future actions contribute to both beneficial and adverse impacts, depending on what stage of implementation they are in. For example, construction and maintenance of fences in the park would contribute to localized minor adverse impacts (due to corridor clearing for fences), but would also contribute to beneficial impacts once the fences are erected by excluding non-native ungulates and assisting in recovery through protection of several native, rare, and federally listed species and their habitats. Likewise, law enforcement activities would contribute to beneficial impacts by protecting rare, unique, threatened, and endangered species from being disturbed or displaced by visitors who violate park rules and regulations, but would also contribute to localized minor adverse impacts should law enforcement officials need to conduct activities that could disturb these species.

Although short- and long-term minor to moderate adverse impacts would result from past, present, and reasonably foreseeable future actions (inside and outside the park), there would be long-term beneficial impacts to rare, unique, threatened, or endangered species, with moderate to major benefits for federally listed species. When combined with the short-term minor to moderate adverse impacts under alternative A, there would be short- and long-term minor to moderate adverse cumulative impacts to rare, unique, threatened, or endangered species and their habitat. Long-term beneficial cumulative impacts would be less likely under alternative A, because non-native ungulate management within the park would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

## Conclusion

Under alternative A, short-term minor to moderate and long-term minor adverse impacts on rare, unique, threatened, or endangered species and their habitat would result from the implementation of non-native ungulate management actions. In the older section of the park, long-term beneficial impacts would result from the continuation of animal exclusion in managed units, with moderate to major beneficial impacts on federally listed species. However, long-term beneficial impacts would be unlikely for Kahuku and areas currently unmanaged (e.g., portions of 'Ōla'a), for which no established population-level objective and fencing strategy has been identified.

The effects of alternative A, when combined with impacts of past, present, and reasonably foreseeable future actions on rare, unique, threatened, or endangered species, would have short- and long-term minor to moderate adverse cumulative impacts. Long-term beneficial cumulative impacts, including moderate to major beneficial impacts on federally listed species, would be less likely under alternative A, because management would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of

management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

## **Alternative B: Comprehensive Management Plan that Uses Lethal Removal Techniques**

### **Analysis**

The removal of non-native ungulates from the park would result in long-term benefits to rare, unique, threatened or endangered species and their habitat. Unlike alternative A, long-term beneficial impacts would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

The removal and exclusion of ungulates would substantially reduce the threats they pose to rare, unique, threatened, or endangered species, and would support ecosystem protection, including recovery and restoration of native plants and animals. Reduction of ungulate browsing would enhance forest regeneration, increasing the availability of food and cover for wildlife species that depend on ground-layer and understory vegetation for survival. Thus, reduction of ungulate browsing would help support the population viability of these species, including ground- and/or shrub-nesting birds (e.g., nēnē and ōma‘o) and native invertebrates in the park. Habitat for non-native mosquitoes would be reduced, which would help protect vulnerable forest birds. The number of wildlife species that would benefit from these changes would increase as the vegetation becomes more diverse and abundant with reduced browsing pressure.

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*The removal and exclusion of ungulates would substantially reduce the threats they pose to rare, unique, threatened, or endangered species, and would support ecosystem protection, including recovery and restoration of native plants and animals.*

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In addition, removal of non-native ungulates and restoration of native vegetation would help to counteract potential pressures of global climate change on rare, unique, threatened, or endangered species. Management of non-native ungulates would contribute to the long-term beneficial effects on sensitive plant and animal species by removing a key stressor on native ecosystems, thereby increasing the capacity of native species to adapt to changes in climate (NPS 2010c). Restoration of fragmented plant communities will assist the local migration of species in response to climate change.

Rare, unique, threatened, or endangered species would be temporarily disturbed during implementation of management actions, including monitoring, fence construction and maintenance, and non-native ungulate removal efforts. The use of helicopters (for monitoring, direct reduction, or fence construction and maintenance), the use of firearms, the use of equipment for fencing, and the presence of people associated with ground-based management actions would introduce unnatural noise in the park, temporarily disrupting and potentially displacing some sensitive species. Any activities, including monitoring, that involve low-flying aircraft may affect the behavior and ecology of wildlife both during and after overflights. However, aerial operations are temporary, and any disruption would end once a management action is complete. The use of firearms, the presence of people associated with management actions, and the use of dogs would contribute to wildlife disturbance. Although individuals could be temporarily displaced during implementation of management actions, they would return after actions are completed, and population stability and viability would not be negatively affected by management actions. These impacts could occur during reproductive periods or in key habitat for native wildlife; however, the park

would take certain steps to minimize the associated effects (see the “Elements Common to All Action Alternatives” section in chapter 2), leading to long-term benefits for rare, unique, threatened, or endangered species.

Despite some minor to moderate short-term and minor long-term adverse effects of non-native ungulate removal (noted above), long-term beneficial effects on rare, unique, threatened, or endangered species and their habitat would occur under alternative B, with moderate to major beneficial impacts on federally listed species. Long-term beneficial impacts would be fully realized under this alternative, because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative B would be the same as alternative A. The short- and long-term minor to moderate adverse and long-term beneficial impacts of past, present, and future actions, when combined with the impacts of implementing alternative B, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts on rare, unique, threatened, or endangered species, with moderate to major beneficial cumulative impacts for federally listed species. Under alternative B, long-term beneficial impacts to rare species and their habitat would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Conclusion**

Under alternative B, short-term minor to moderate and long-term minor adverse impacts on rare, unique, threatened, or endangered species and their habitat would result from the implementation of monitoring and management actions. Long-term beneficial impacts would be fully realized under this alternative, with moderate to major beneficial impacts on federally listed species because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

The effects of alternative B, when combined with impacts of past, present, and reasonably foreseeable future actions, would have short- to long-term minor to moderate adverse and long-term beneficial and cumulative impacts, with moderate to major beneficial cumulative impacts on federally listed species.

## **Alternative C: Comprehensive Management Plan that Maximizes Efficiency by Expanding Lethal Removal Techniques and Discontinuing the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative C would result in minor to moderate short-term and minor long-term adverse impacts on rare, unique, threatened, or endangered species through implementation of management actions. Long-term beneficial impacts would be fully realized under this alternative, with moderate to major beneficial impacts for federally listed species.

Because lethal techniques would be expanded and enhanced, and volunteers would not be used during direct reduction efforts under alternative C, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative B. The increased efficiency associated with discontinuing the use of volunteers is based on additional work required by NPS staff to recruit, administer, train and direct volunteers in the field, and data that show that park staff remove more ungulates per day when they conduct direct reduction (ground shooting) themselves, compared to when they are accompanied by volunteers (Stephens et al. 2008).

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative C would be the same as alternative A. Similar to alternative B, the short- and long-term minor to moderate adverse and long-term beneficial impacts of past, present, and future actions, when combined with the impacts of implementing alternative C, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts on rare, unique, threatened, or endangered species, with moderate to major beneficial cumulative impacts for federally listed species.

### **Conclusion**

Under alternative C, minor to moderate short-term and minor long-term adverse effects on rare, unique, threatened, or endangered species and their habitat would result from the implementation of monitoring and management actions. Long-term beneficial effects would be fully realized under this alternative, with moderate to major beneficial impacts on federally listed species. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative C than under alternative B. The effects of alternative C, when combined with impacts of past, present, and reasonably foreseeable future actions on rare, unique, threatened, or endangered species, would have short- to long-term minor to moderate adverse and long-term beneficial and cumulative impacts, with moderate to major beneficial cumulative impacts on federally listed species.

## **Alternative D: Comprehensive Management Plan that Maximizes Flexibility of Management Techniques**

### **Analysis**

Similar to alternative B, alternative D would result in minor to moderate short-term and minor long-term adverse impacts on rare, unique, threatened, or endangered species through implementation of management actions. Long-term beneficial impacts would be fully realized under this alternative, with moderate to major beneficial impacts for federally listed species.

Under alternative D, it is possible that increased human and vehicular traffic associated with potential relocation activities could cause additional disturbance to rare species and their habitat during the process of driving animals to adjacent lands. However, these impacts would be short-term and localized, and similar to impacts of other management actions.

Although the expansion and enhancement of lethal removal techniques under alternative D would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the continued use of volunteers and the expansion of non-lethal techniques would counteract this to some extent. Inclusion of non-lethal removal would require additional staff time and park resources to relocate animals to adjacent lands, and may increase the time associated with reduction actions over the life of the

plan, as well as time needed to reach the post-reduction phase. As a result, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative D would be the same as alternative A. Similar to alternative B, the short- and long-term minor to moderate adverse and long-term beneficial impacts of past, present, and future actions, when combined with the impacts of implementing alternative D, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts on rare, unique, threatened, or endangered species, with moderate to major beneficial cumulative impacts for federally listed species.

### **Conclusion**

Under alternative D, minor to moderate short-term and minor long-term adverse effects on rare, unique, threatened, or endangered species and their habitat would result from the implementation of monitoring and management actions. Long-term beneficial effects would be fully realized under this alternative, with moderate to major beneficial impacts on federally listed species. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly under alternative D than under alternative C. The effects of alternative D, when combined with impacts of past, present, and reasonably foreseeable future actions on rare, unique, threatened, or endangered species, would have short- to long-term minor to moderate adverse and long-term beneficial and cumulative impacts, with moderate to major beneficial cumulative impacts on federally listed species.

## **Alternative E: Comprehensive Management Plan that Increases Flexibility of Management Techniques While Limiting the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative E would result in minor to moderate short-term and minor long-term adverse impacts on rare, unique, threatened, or endangered species through implementation of management actions. Long-term beneficial impacts would be fully realized under this alternative, with moderate to major beneficial impacts for federally listed species.

Under alternative E, it is possible that increased human and vehicular traffic associated with potential relocation activities could cause additional disturbance to rare species and their habitat during the process of driving animals to adjacent lands. However, these impacts would be short-term and localized, and similar to impacts of other management actions.

Although the expansion and enhancement of lethal removal techniques under alternative E would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the expansion of non-lethal techniques would counteract this to some extent. However, because volunteers would not be used during direct reduction efforts under alternative E, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative D, but less quickly than under alternative C.

## **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative E would be the same as alternative A. Similar to alternative B, the short- and long-term minor to moderate adverse and long-term beneficial impacts of past, present, and future actions, when combined with the impacts of implementing alternative E, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts on rare, unique, threatened, or endangered species, with moderate to major beneficial cumulative impacts for federally listed species.

## **Conclusion**

Under alternative E, short- and long-term minor to moderate adverse effects on rare, unique, threatened, or endangered species and their habitat would result from the implementation of monitoring and management actions. Long-term beneficial effects would be fully realized under this alternative, with moderate to major beneficial impacts on federally listed species. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative E than under alternative D, but less quickly than under alternative C. The effects of alternative E, when combined with impacts of past, present, and reasonably foreseeable future actions on rare, unique, threatened, or endangered species, would have short- to long-term minor to moderate adverse and long-term beneficial and cumulative impacts, with moderate to major beneficial cumulative impacts on federally listed species.

## **CULTURAL/HISTORIC RESOURCES**

### **GUIDING REGULATIONS AND POLICIES**

The NPS categorizes cultural resources as archeological resources, cultural landscapes, historic structures, museum objects, and ethnographic resources.

The descriptions of effects on cultural resources that are presented in this section are intended to comply with the requirements of both NEPA and Section 106 of the *National Historic Preservation Act*. In accordance with the regulations of the Advisory Council on Historic Preservation (Advisory Council) implementing Section 106 (36 CFR 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 on the National Register; (3) applying the criteria of an *adverse effect* to affected cultural resources either listed on or eligible to be listed on the National Register; and (4) considering ways to avoid, minimize, or mitigate adverse effects.

### **METHODOLOGY, ASSUMPTIONS, AND IMPACT THRESHOLDS**

Under the Advisory Council’s regulations, a determination of either *adverse effect* or *no adverse effect* must also be made for affected cultural resources eligible for listing on the National Register. An adverse effect occurs whenever an impact alters, directly or indirectly, any of the characteristics that qualify the resource for inclusion on the National Register (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 on the National Register.

## Archeological Resources

### Adverse

*Duration:* All impacts to archeological resources are considered long term.

*Negligible:* The impact on archeological sites is at the lowest level of detection, barely perceptible and not measurable. For purposes of Section 106, the determination of effect would be *no adverse effect*.

*Minor:* The impact on archeological sites is measurable or perceptible, but it is slight and localized within a relatively small area of a site or group of sites. The impact does not affect the character-defining features of a listed or eligible National Register archeological site and would not have a permanent effect on the integrity of any archeological sites. For purposes of Section 106, the determination of effect would be *no adverse effect*.

*Moderate:* The impact is measurable and perceptible. The impact is readily apparent and/or changes one or more character-defining features of an archeological resource to the extent that its National Register eligibility is jeopardized. For purposes of Section 106, the determination of effect would be *adverse effect*.

*Major:* The impact on archeological sites is substantial, noticeable, and permanent. For National Register eligible or listed archeological sites, the impact changes one or more character-defining features of an archeological resource, diminishing the integrity of the resource to the extent that it is no longer eligible for listing on the National Register. For purposes of Section 106, the determination of effect would be *adverse effect*.

### Beneficial

*Duration:* All impacts to archeological resources are considered long term.

*Negligible:* The impact on archeological sites is at the lowest level of detection, barely perceptible and not measurable. For purposes of Section 106, the determination of effect would be *no adverse effect*.

*Minor:* A site would be preserved in its natural state. For purposes of Section 106, the determination of effect would be *no adverse effect*.

*Moderate:* The site would be stabilized. For purposes of Section 106, the determination of effect would be *no adverse effect*.

*Major:* Active intervention would be undertaken to preserve the site. For purposes of Section 106, the determination of effect would be *no adverse effect*.

## Cultural Landscapes

### Adverse

*Negligible:* Impact is at the lowest levels of detection, with neither adverse nor beneficial consequences. The determination of effect for Section 106 would be *no adverse effect*.

*Minor:* Alteration of patterns or features of the landscape would not diminish the overall integrity of the landscape. The determination of effect for Section 106 would be *no adverse effect*.

*Moderate:* Alteration of patterns or features of the landscape would diminish the overall integrity of the landscape. The determination of effect for Section 106 would be *adverse effect*. A memorandum of agreement is executed between the NPS and applicable state or tribal historic preservation officer and, if necessary, the Advisory Council in accordance with 36 CFR 800.6(b). Measures identified in the memorandum of agreement to minimize or mitigate adverse impacts reduce the intensity of impact under NEPA from major to moderate.

*Major:* Alteration of patterns or features of the landscape would diminish the overall integrity of the landscape. The determination of effect for Section 106 would be *adverse effect*. Measures to minimize or mitigate adverse impacts cannot be agreed upon and the NPS and applicable state or tribal historic preservation officer and/or Advisory Council are unable to negotiate and execute a memorandum of agreement in accordance with 36 CFR 800.6(b).

### Beneficial

*Negligible:* Impact is at the lowest levels of detection, with neither adverse nor beneficial consequences. The determination of effect for Section 106 would be *no adverse effect*.

*Minor:* Preservation of landscape patterns and features in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes. The determination of effect for Section 106 would be *no adverse effect*.

*Moderate:* Rehabilitation of a landscape or its patterns and features in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes. The determination of effect for Section 106 would be *no adverse effect*.

*Major:* Restoration of a landscape or its patterns and features in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes. The determination of effect for Section 106 would be *no adverse effect*.

## Ethnographic Resources

### Adverse

- Negligible:* The impact would be barely perceptible and would neither alter resource conditions, such as traditional access or site preservation, nor the relationship between the resource and the affiliated group's body of beliefs and practices. There would be no change to a group's beliefs and practices. For purposes of Section 106, the determination of effect would be *no adverse effect*.
- Minor:* The impact would be slight but noticeable and would neither appreciably alter resource conditions, such as traditional access or site preservation, nor the relationship between the resource and the affiliated group's body of beliefs and practices. For purposes of Section 106, the determination of effect would be *no adverse effect*.
- Moderate:* The impact would be apparent and would alter resource conditions. The alternative or its outcome would interfere with traditional access, site preservation, or the relationship between the resource and the affiliated group's beliefs and practices, even though the group's beliefs and practices would survive. For purposes of Section 106, the determination of effect would be *adverse effect*.
- Major:* The impact would alter resource conditions. The alternative or its outcome would block or greatly affect traditional access, site preservation, or the relationship between the resource and the affiliated group's beliefs and practices, to the extent that the survival of a group's beliefs and/or practices would be jeopardized. For purposes of Section 106, the determination of effect would be *adverse effect*.

### Beneficial

- Negligible:* The impact would be barely perceptible and would neither alter resource conditions, such as traditional access or site preservation, nor the relationship between the resource and the affiliated group's body of beliefs and practices. There would be no change to a group's beliefs and practices. For purposes of Section 106, the determination of effect would be *no adverse effect*.
- Minor:* The action would allow traditional access and/or accommodate a group's traditional practices or beliefs. For purposes of Section 106, the determination of effect would be *no adverse effect*.
- Moderate:* The action would facilitate a group's beliefs and practices. For purposes of Section 106, the determination of effect would be *no adverse effect*.
- Major:* The action would encourage a group's beliefs or practices. For purposes of Section 106, the determination of effect would be *no adverse effect*.

## **ARCHEOLOGICAL RESOURCES: IMPACTS OF THE ALTERNATIVES**

### **Alternative A: No Action (Continue Existing Non-native Ungulate Management Activities)**

#### **Analysis**

Under alternative A, management actions that could adversely affect archeological resources are construction of fences for boundaries and internal enclosures. Placement of fences could damage surface features and unknown subsurface archeological sites when posts are driven into the ground. In addition, viewsheds associated with sensitive archeological sites could be negatively impacted by fences. Prior to construction, repair or replacement, fences are surveyed as needed and fence locations rerouted to avoid impacts to archeological resources and to minimize disturbance to the cultural viewshed. Conversely, removal and exclusion of non-native ungulates would protect archeological sites by preventing trampling of features and artifacts by animals, and destabilizing of the soil surrounding cultural deposits and human remains.

Alternative A would result in long-term negligible to minor adverse impacts on archeological sites and associated viewsheds. In the older section of the park, long-term minor to moderate beneficial impacts would result from the continuation of animal exclusion in managed units. However, long-term benefits would be unlikely for Kahuku and areas currently unmanaged (e.g., portions of ‘Ōla‘a), for which no established population-level objective and fencing strategy has been identified. Also, the implementation of management tools and monitoring would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities. Because alternative A would not incorporate the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, it would be uncertain whether the NPS would progress through management phases, monitor, and apply management tools consistently as staff and institutional knowledge change over time.

#### **Cumulative Impacts**

Other past, present, and reasonably foreseeable future actions in and around the park have affected or could affect archeological resources. Although management plans ensure protection of archeological resources, future activities associated with the development and maintenance of facilities (grading, filling, construction, and inventory) at the park, including trails, roads, shelters and campsites, could contribute to long-term adverse impacts on archeological resources. Development both inside and directly outside (the latter applicable if archeological sites are close to or stretch across park boundaries) the park, including historic roads, trails, and other structures, has likely impacted archeological sites in the park because of ground disturbance during construction. While all archeological sites are subject to direct or indirect impacts, shrines, mounds, stone alignments, and rock art are especially susceptible to damage, either directly or indirectly, by development. Development outside the park contributes to damage, as roads and trails encroach on park boundaries and provide access to sensitive archeological sites. Grazing and past ranching activities (in the park and on adjacent lands) can be destructive to archeological sites, as ground is disturbed and cultural material is trampled or uprooted. While park visitation is essential to the park, past and projected increased access and off-trail travel can impact archeological resources such as culturally modified caves when visitors inadvertently or purposely vandalize sites. Law enforcement activities would minimize these impacts by protecting archeological resources from being damaged by visitors who violate park rules and regulations.

Changes in the fire regime due to habitat fragmentation and non-native species invasions pose a threat to archeological resources as well. Fire can damage shrines and rock art by splitting and flaking of rock fragments. However, the park’s fire management plan (NPS 2005a) outlines procedures and approaches

for the monitoring and suppression of wildfires, and mitigation measures to reduce the chance of wildfire and of damage to archeological features. The NPS and Big Island Wildfire Coordinating Group have cosponsored community wildfire protection plans, which have been developed by local communities in the vicinity of the park, outlining mitigation measures to reduce the chances of wildfires occurring in adjacent communities (Laitinen 2006a, 2006b).

Many past, current, and future actions, plans, and programs at the park and in surrounding areas provide benefits for archeological resources. Natural resource and watershed protection on lands in and adjacent to the park has previously supported and will continue to support the protection of archeological resources by managing ingress of non-native ungulates and implementing mitigation measures. The future implementation of the GMP for the park will also involve prescriptions for desired conditions related to the protection of cultural resources, including archeological resources, balanced with those for visitor use.

In addition, past acquisitions, such as Kahuku, and future acquisitions of new lands would contribute to the inventory of archeological resources in the park. Future implementation of several management plans, including those in development—the GMP and the *Ala Kahakai National Historic Trail Management Plan* (NPS n.d.a, 2004d)—would have long-term minor beneficial impacts on archeological resources because the plans contain mitigation measures for the protection of cultural resources.

These past, present, and reasonably foreseeable future actions would have long-term minor to moderate adverse and long-term minor beneficial impacts on archeological resources. Past, present, and reasonably foreseeable future actions, when combined with impacts under alternative A, would result in long-term minor to moderate adverse cumulative impacts. Long-term beneficial cumulative impacts would be less likely under alternative A, because non-native ungulate management within the park would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

## **Conclusion**

Under alternative A, long-term negligible to minor adverse impacts on archeological sites and associated viewsheds would result from the implementation of management actions. In the older section of the park, long-term minor to moderate beneficial impacts would result from the continuation of animal exclusion in managed units. However, long-term benefits would be unlikely for Kahuku and areas currently unmanaged (e.g., portions of ‘Ōla‘a), for which no established population-level objective and fencing strategy has been identified in a comprehensive and systematic plan. The effects of alternative A, when combined with impacts of past, present, and reasonably foreseeable future actions on archeological resources, would have long-term minor to moderate adverse cumulative impacts on archeological resources. Long-term beneficial cumulative impacts would be less likely under alternative A, because management would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

## **Alternative B: Comprehensive Management Plan that Uses Lethal Removal Techniques**

### **Analysis**

Under alternative B, management actions that could adversely affect archeological resources are construction of fences for boundaries and internal enclosures. However, impacts would be mitigated by conducting surveys and rerouting fence alignments to avoid impacts to archeological resources and to

minimize disturbance to the cultural viewshed. Consequently, adverse impacts would be long-term, negligible to minor. In the long term, there would be minor to moderate beneficial impacts from the removal and exclusion of non-native ungulates, which would protect archeological sites by preventing trampling of features and artifacts by animals, and destabilizing of the soil surrounding cultural deposits and human remains. Beneficial impacts would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative B would be the same as alternative A. The long-term minor to moderate adverse and long-term minor beneficial impacts of past, present, and reasonably foreseeable future actions on archeological resources, when combined with the impacts of implementing alternative B, would have long-term minor to moderate adverse and long-term moderate beneficial cumulative impacts on archeological resources. Under alternative B, long-term beneficial impacts to rare species and their habitat would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Conclusion**

Under alternative B, long-term negligible to minor adverse impacts on archeological sites and associated viewsheds would result from the implementation of management actions. Long-term minor to moderate beneficial impacts to archeological resources would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

The effects of alternative B, when combined with impacts of past, present, and reasonably foreseeable future actions on archeological resources, would have long-term minor to moderate adverse and long-term moderate beneficial cumulative impacts.

## **Alternative C: Comprehensive Management Plan that Maximizes Efficiency by Expanding Lethal Removal Techniques and Discontinuing the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative C would result in long-term negligible to minor adverse impacts on archeological resources. Long-term minor to moderate beneficial impacts to archeological resources would be fully realized under this alternative.

Because lethal techniques would be expanded and enhanced, and volunteers would not be used during direct reduction efforts under alternative C, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative B. The increased efficiency associated with discontinuing the use of volunteers is based on additional work required by NPS staff to recruit, administer, train and direct volunteers in the field, and data that show that park staff remove more ungulates per day when they conduct direct reduction (ground shooting) themselves, compared to when they are accompanied by volunteers (Stephens et al. 2008).

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative C would be the same as alternative A. Similar to alternative B, the long-term minor to moderate adverse and long-term minor beneficial impacts of past, present, and reasonably foreseeable future actions on archeological resources, when combined with the impacts of implementing alternative C, would have long-term minor to moderate adverse and long-term moderate beneficial cumulative impacts.

### **Conclusion**

Under alternative C, long-term negligible to minor adverse impacts on archeological sites and associated viewsheds would result from the implementation of management actions. Long-term minor to moderate beneficial impacts would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative C than under alternative B. The effects of alternative C, when combined with impacts of past, present, and reasonably foreseeable future actions on archeological resources, would have long-term minor to moderate adverse and long-term moderate beneficial cumulative impacts.

### **Alternative D: Comprehensive Management Plan that Maximizes Flexibility of Management Techniques**

#### **Analysis**

Similar to alternative B, alternative D would result in long-term negligible to minor adverse impacts on archeological resources. Long-term minor to moderate beneficial impacts to archeological resources would be fully realized under this alternative.

Under alternative D, it is possible that increased human and vehicular traffic associated with potential relocation activities could cause additional trampling and damage to archeological resources during the process of driving animals to adjacent lands. However, surveys would be conducted and driving routes located away from sensitive resources to minimize the potential for impacts.

Although the expansion and enhancement of lethal removal techniques under alternative D would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the continued use of volunteers and the expansion of non-lethal techniques would counteract this to some extent. Inclusion of non-lethal removal would require additional staff time and park resources to relocate animals to adjacent lands, and may increase the time associated with reduction actions over the life of the plan, as well as the time needed to reach the post-reduction phase. As a result, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative D would be the same as alternative A. Similar to alternative B, the long-term minor to moderate adverse and long-term minor beneficial impacts of past, present, and reasonably foreseeable future actions on archeological resources, when combined with the impacts of implementing alternative D would have long-term minor to moderate adverse and long-term moderate beneficial cumulative impacts on archeological resources.

## **Conclusion**

Under alternative D, long-term negligible to minor adverse impacts on archeological sites and associated viewsheds would result from the implementation of management actions. Long-term minor to moderate beneficial impacts would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly under alternative D than under alternative C. The effects of alternative D, when combined with impacts of past, present, and reasonably foreseeable future actions on archeological resources, would have long-term minor to moderate adverse and long-term moderate beneficial cumulative impacts.

## **Alternative E: Comprehensive Management Plan that Increases Flexibility of Management Techniques While Limiting the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative E would result in long-term negligible to minor adverse impacts on archeological resources. Long-term minor to moderate beneficial impacts to archeological resources would be fully realized under this alternative.

Similar to alternative D, it is possible that potential relocation activities could cause additional trampling and damage to archeological resources during the process of driving animals to adjacent lands under alternative E.

Although the expansion and enhancement of lethal removal techniques under alternative E would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the expansion of non-lethal techniques would counteract this to some extent. However, because volunteers would not be used during direct reduction efforts under alternative E, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative D, but less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative E would be the same as alternative A. Similar to alternative B, the long-term minor to moderate adverse and long-term minor beneficial impacts of past, present, and reasonably foreseeable future actions on archeological resources, when combined with the impacts of implementing alternative E would have long-term minor to moderate adverse and long-term moderate beneficial cumulative impacts on archeological resources.

### **Conclusion**

Under alternative E, long-term negligible to minor adverse impacts on archeological sites and associated viewsheds would result from the implementation of management actions. Long-term minor to moderate beneficial impacts would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative E than under alternative D, but less quickly than under alternative C. The effects of alternative E, when combined with impacts of past, present, and reasonably foreseeable future actions on archeological resources, would have long-term minor to moderate adverse and long-term moderate beneficial cumulative impacts.

## **CULTURAL LANDSCAPES: IMPACTS OF THE ALTERNATIVES**

### **Alternative A: No Action (Continue Existing Non-native Ungulate Management Activities)**

#### **Analysis**

In general, non-native feral and wild ungulates would probably not be considered a component of any of the cultural landscapes in the park. The connection that non-native ungulates have with the cultural landscape is their adverse impact on vegetation. Ungulate browsing, trampling, and rototilling cause depletion in the park's native herbaceous and shrub vegetation, as well as continuing to prevent the regeneration of native plant species. Removal and exclusion of animals would protect the remaining plant species and cultural plantings that have existed historically in the park and allow for reestablishment and/or reintroduction of historical species resulting in long-term minor beneficial impacts.

Although not designated a cultural landscape, portions of Kahuku (particularly the Parker period, pre-1947) could be eligible for future listing. With the cessation of commercial cattle operations, the additional removal of non-native feral and wild ungulates could result in the return of native plant communities and invasive plants, which would consequently alter the ranching landscape. The impacts of invasive weeds would be minimized by implementation of current weed management programs. Also, the park could decide to maintain contributing elements of the ranching landscape if there is future determination for listing (e.g., similar to 'Āinahou Ranch House and Gardens). This alternative would have both long-term minor beneficial effects and possible long-term minor adverse impacts on cultural landscapes.

The woven-wire, 6-foot fences would introduce new structural elements into the park's overall landscape. The exact locations of fences would be determined during implementation. In Kahuku and 'Āinahou, where there are historic and existing pasture fences, the park would use these existing alignments for non-native ungulate fences as much as feasible in order to minimize the introduction of new fence lines. Also, placing fences behind vegetation or taking advantage of topography would help to conceal them from sight. Existing fence corridors have been surveyed for sensitive cultural areas and would be resurveyed prior to fence repair or replacement as needed. Although construction of fencing would cause long-term minor adverse impacts on cultural landscapes, there would be long-term beneficial impacts from the preservation of endemic flora and fauna of the park, which are a part of the cultural landscapes.

Alternative A would result in long-term minor adverse impacts on cultural landscapes. In the older section of the park, long-term minor beneficial impacts on cultural landscapes would result from the continuation of animal exclusion in managed units. However, long-term benefits would be unlikely for cultural landscapes still inhabited by non-native ungulates, for which no established population-level objective and fencing strategy has been identified. Also, the implementation of management tools and monitoring would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities. Because alternative A would not incorporate the comprehensive, systematic approach described in the "Elements Common to All Action Alternatives" section in chapter 2, it would be uncertain whether the NPS would progress through management phases, monitor, and apply management tools consistently as staff and institutional knowledge change over time.

#### **Cumulative Impacts**

Other past, present, and reasonably foreseeable future actions in and around the park have affected or could affect cultural landscapes. Development inside the park, including historic roads, trails, and other structures, can impact cultural landscapes in the park. Development outside the park contributes to damage, as roads and trails encroach on park boundaries and affect views associated with cultural

landscapes. Grazing and past ranching activities (in the park and on adjacent lands) can be destructive to cultural landscapes if the theme of the designated landscape is not related to ranching. For example, the Crater Rim Historic District, the Kīlauea Historic District, and some of the other landscapes, such as military camps, were not designated based on a ranching theme. While tourism is essential to the park, past and projected increased access and off-trail travel can impact cultural landscapes by adding incongruent elements. As mentioned previously, past, present, and proposed fencing can impact visual elements of cultural landscapes. The cumulative impacts from these actions would be long term, minor, and adverse.

Many past, current, and future actions, plans, and programs at the park and surrounding areas provide benefits for cultural landscapes. The acquisition of the Kahuku Unit resulted in the increased protection of cultural resources on these lands due to implementing management actions under the interim operating plan that were not previously being implemented. The future implementation of the GMP (currently in development) for the park will also involve prescriptions for desired conditions related to the protection of cultural landscapes balanced with those for visitor use, which is expected to increase as a result of increased tourism inside and outside the park. Additional actions providing long-term beneficial impacts for cultural landscapes include park educational programs and interpretation activities, the future development and implementation of the ATMP, and the *Ala Kahakai National Historic Trail Management Plan* (FAA n.d.; NPS 2004d).

Changes in the fire regime due to habitat fragmentation and non-native species invasions pose a threat to cultural landscapes. Particularly in dry and seasonally dry vegetation types, fire is promoted by non-native plants and many non-native plant species recover quickly after fire, suppressing native species recovery (Tunison et al. 2001). However, the park's fire management plan (NPS 2005a) outlines procedures and approaches for the monitoring and suppression of wildfires, mitigation measures to reduce the chance of wildfire, and impacts to cultural resources. The NPS and Big Island Wildfire Coordinating Group have cosponsored community wildfire protection plans, which have been developed by local communities in the vicinity of the park, outlining mitigation measures to reduce the chances of wildfire occurring in communities that could potentially alter the cultural landscapes in the park (Laitinen 2006a, 2006b). The cumulative impacts from these actions would be long term, minor, and adverse.

These past, present, and reasonably foreseeable future actions would have long-term minor adverse and beneficial impacts on cultural landscapes. When combined with the long-term minor adverse impacts under alternative A, there would be long-term, minor, both adverse and beneficial cumulative impacts to cultural landscapes. Long-term beneficial cumulative impacts associated with alternative A, would be less likely because non-native ungulate management within the park would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

## **Conclusion**

Under alternative A, long-term minor adverse impacts on cultural landscapes would result from implementation of management actions. Designed landscapes would be less impacted than either historic vernacular landscapes or ethnographic landscapes. In the older section of the park, long-term minor beneficial impacts on cultural landscapes would result from the continuation of animal exclusion in managed units. However, long-term benefits would be unlikely for cultural landscapes still inhabited by non-native ungulates, for which no established population-level objective and fencing strategy has been identified in a comprehensive and systematic plan. The effects of alternative A, when combined with impacts of past, present, and reasonably foreseeable future actions on cultural landscapes, would have long-term minor adverse cumulative impacts on cultural resources. Long-term beneficial cumulative

impacts would be less certain under alternative A, because management would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

## **Alternative B: Comprehensive Management Plan that Uses Lethal Removal Techniques**

### **Analysis**

Alternative B would result in long-term minor adverse impacts to cultural landscapes. The woven-wire, 6-foot fences would introduce new structural elements into the park's overall landscape. The exact locations of fences would be determined during implementation. Where there are historic and existing pasture fences, the park would use these existing alignments for non-native ungulate fences as much as feasible in order to minimize the introduction of new fence lines. Also, placing fences behind vegetation or taking advantage of topography would help to conceal them from sight. Existing fence corridors have been surveyed for sensitive cultural areas and would be resurveyed prior to fence repair or replacement as needed. Although construction of fencing would cause long-term minor adverse impacts on cultural landscapes, there would be long-term beneficial impacts from the preservation of the remaining plant species and cultural plantings that have existed historically in the park and allow for reestablishment and/or reintroduction of historical species.

Although not designated a cultural landscape, portions of Kahuku (particularly the Parker period, pre-1947) could be eligible for future listing. With the cessation of commercial cattle operations, the additional removal of non-native feral and wild ungulates could result in the return of native plant communities as well as invasive plants, which would consequently alter the ranching landscape. The impacts of invasive weeds would be minimized by implementation of current weed management programs. Also, the park could decide to maintain contributing elements of the ranching landscape if there is future determination for listing (e.g., similar to 'Āinahou Ranch House and Gardens). This alternative would have both long-term minor beneficial effects and possible long-term minor adverse impacts on cultural landscapes.

Alternative B would result in long-term minor adverse and long-term minor beneficial impacts on cultural landscapes. Beneficial impacts would be fully realized under this alternative because the comprehensive, systematic approach described in the "Elements Common to All Action Alternatives" section in chapter 2, would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative B would be the same as alternative A. The long-term minor adverse and beneficial impacts of past, present, and reasonably foreseeable future actions on cultural landscapes, when combined with the impacts of implementing alternative B, would have long-term, minor, both adverse and beneficial cumulative impacts on cultural landscapes. Under alternative B, long-term beneficial impacts would be fully realized under this alternative because the comprehensive, systematic approach described in the "Elements Common to All Action Alternatives" section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

## **Conclusion**

Under alternative B, long-term minor adverse impacts to cultural landscapes would result from the implementation of management actions. Designed landscapes would be less impacted than either historic vernacular landscapes or ethnographic landscapes. Long-term minor beneficial impacts to cultural landscapes would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

The effects of alternative B, when combined with impacts of past, present, and reasonably foreseeable future actions on cultural landscapes, would have long-term minor adverse and long-term minor beneficial cumulative impacts.

## **Alternative C: Comprehensive Management Plan that Maximizes Efficiency by Expanding Lethal Removal Techniques and Discontinuing the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative C would result in long-term minor adverse impacts to cultural landscapes. Long-term minor beneficial impacts would be fully realized under this alternative.

Because lethal techniques would be expanded and enhanced, and volunteers would not be used during direct reduction efforts under alternative C, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative B. The increased efficiency associated with discontinuing the use of volunteers is based on additional work required by NPS staff to recruit, administer, train and direct volunteers in the field, and data that show that park staff remove more ungulates per day when they conduct direct reduction (ground shooting) themselves, compared to when they are accompanied by volunteers (Stephens et al. 2008).

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative C would be the same as alternative A. Similar to alternative B, the long-term minor adverse and beneficial impacts of past, present, and reasonably foreseeable future actions on cultural landscapes, when combined with the impacts of implementing alternative C, would have long-term, minor, both adverse and beneficial cumulative impacts on cultural landscapes.

## **Conclusion**

Under alternative C, long-term minor adverse impacts to cultural landscapes would result from the implementation of management actions. Designed landscapes would be less impacted than either historic vernacular landscapes or ethnographic landscapes. Long-term minor beneficial impacts to cultural landscapes would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative C than under alternative B. The effects of alternative C, when combined with impacts of past, present, and reasonably foreseeable future actions on cultural landscapes, would have long-term minor adverse and long-term minor beneficial cumulative impacts.

## **Alternative D: Comprehensive Management Plan that Maximizes Flexibility of Management Techniques**

### **Analysis**

Similar to alternative B, alternative D would result in long-term minor adverse impacts to cultural landscapes. Long-term minor beneficial impacts would be fully realized under this alternative.

Although the expansion and enhancement of lethal removal techniques under alternative D would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the continued use of volunteers and the expansion of non-lethal techniques would counteract this to some extent. Inclusion of non-lethal removal would require additional staff time and park resources to relocate animals to adjacent lands, and may increase the time associated with reduction actions over the life of the plan, as well as the time needed to reach the post-reduction phase. As a result, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative D would be the same as alternative A. Similar to alternative B, the long-term minor and beneficial adverse impacts of past, present, and reasonably foreseeable future actions on cultural landscapes, when combined with the impacts of implementing alternative D, would have long-term, minor, both adverse and beneficial cumulative impacts on cultural landscapes.

### **Conclusion**

Under alternative D, long-term minor adverse impacts to cultural landscapes would result from the implementation of management actions. Designed landscapes would be less impacted than either historic vernacular landscapes or ethnographic landscapes. Long-term minor beneficial impacts to cultural landscapes would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly under alternative D than under alternative C. The effects of alternative D, when combined with impacts of past, present, and reasonably foreseeable future actions on cultural landscapes, would have long-term minor adverse and long-term minor beneficial cumulative impacts.

## **Alternative E: Comprehensive Management Plan that Increases Flexibility of Management Techniques While Limiting the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative E would result in long-term minor adverse impacts to cultural landscapes. Long-term minor beneficial impacts would be fully realized under this alternative.

Although the expansion and enhancement of lethal removal techniques under alternative E would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the expansion of non-lethal techniques would counteract this to some extent. However, because volunteers would not be used during direct reduction efforts under alternative E, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative D, but less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative E would be the same as alternative A. Similar to alternative B, the long-term minor adverse and beneficial impacts of past, present, and reasonably foreseeable future actions on cultural landscapes, when combined with the impacts of implementing alternative E, would have long-term, minor, both adverse and beneficial cumulative impacts on cultural landscapes.

### **Conclusion**

Under alternative E, long-term minor adverse impacts to cultural landscapes would result from the implementation of management actions. Designed landscapes would be less impacted than either historic vernacular landscapes or ethnographic landscapes. Long-term minor beneficial impacts to cultural landscapes would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative E than under alternative D, but less quickly than under alternative C. The effects of alternative E, when combined with impacts of past, present, and reasonably foreseeable future actions on cultural landscapes, would have long-term minor adverse and long-term minor beneficial cumulative impacts.

## **ETHNOGRAPHIC RESOURCES: IMPACTS OF THE ALTERNATIVES**

### **Alternative A: No Action (Continue Existing Non-native Ungulate Management Activities)**

#### **Analysis**

Implementation of management actions, including monitoring, direct reduction with firearms, and fencing, would temporarily create noise from the use of helicopters and/or firearms that could affect cultural practitioners in the area. Temporary closures, due to control efforts, could also interfere with cultural practitioners. However, closures are usually for a few hours and rarely last more than a day. Also, management actions are typically confined to specific areas. Similarly, monitoring activities and fence construction involving the use of helicopters are also intermittent. Judging by past experience, closures would generally be used infrequently, and the public would be notified of them in advance so they can adjust their plans. Consequently, there would be short-term minor adverse impacts associated with implementation of management actions.

Ungulate control would support the protection and restoration of the native flora and fauna regarded as ethnographic resources to Native Hawaiians. Although Polynesian pigs were held in regard in Native Hawaiian legends, the European and other domestic strains of pigs have become the dominant type in the wild. These animals became feral and ventured into native forest where they proved destructive to the native flora. In the Hawaiian culture everything has a degree of sacredness, including the native plants, birds, insects and the communities they form. In particular, upland plant communities are valued for supplying aquifers and providing the seed sources for forest regeneration.

During consultation meetings held with the Kupuna Consultation Group, one of the concerns voiced was that people should be able to hunt to put food on their table. Although subsistence hunting has never been legal in the park, under alternative A, there would be limited opportunities for meat salvage by volunteers, who typically participate once in ground shooting operations directed by park staff. In addition, the park is surrounded by public hunting areas in state game and forest reserves that are used by the communities near the park.

Alternative A would result in short-term minor adverse impacts on ethnographic resources through implementation of management actions. In the older section of the park, long-term moderate to major beneficial impacts would result through the continuation of animal exclusion in managed units. However, long-term beneficial impacts would be unlikely for Kahuku and areas currently unmanaged (e.g., portions of ‘Ōla‘a), for which no established population-level objective and fencing strategy has been identified. Also, the implementation of management tools and monitoring would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities. Because alternative A would not incorporate the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, it would be less likely that the NPS would progress through management phases, monitor, and apply management tools consistently as staff and institutional knowledge change over time.

### **Cumulative Impacts**

Other past, present, and reasonably foreseeable future actions in and around the park have affected or could affect ethnographic resources. Although management plans ensure protection of ethnographic resources, past, present and future activities associated with the development and maintenance of facilities (grading, filling, construction, and inventory) at the park, including trails and roads, administrative buildings, and campsites, contribute to long-term adverse impacts on ethnographic resources. Development both inside and directly outside the park, including historic roads, trails, and other structures, has likely impacted ethnographic resources in the park because of the ground, vegetation, and other resource disturbance during construction. While all ethnographic resources are subject to direct or indirect impacts, sacred shrines, mounds, stone alignments, and rock art are especially susceptible to damage, either directly or indirectly, by development. Development outside the park contributes to damage as roads and trails encroach on park boundaries and provide access to ethnographic resource locations. Grazing and ranching activities (in the park and in adjacent lands) can be destructive to ethnographic resources, as native vegetation and wildlife habitat are removed. While park visitation is essential to the park, past and projected increased access and off-trail travel can impact ethnographic resources, such as culturally modified caves, if visitors inadvertently or purposely vandalize sensitive sites. As mentioned previously, past, present, and proposed future fencing can damage ethnographic resources. The impacts from these past, present, and reasonably foreseeable future would be long term, minor, and adverse.

Changes in the fire regime due to habitat fragmentation and non-native species invasions pose a threat to ethnographic resources as well. However, the park’s fire management plan (NPS 2005a) outlines procedures and approaches for the monitoring and suppression of wildfires, mitigation measures to reduce the chance of wildfire, and impacts to cultural and natural resources. The NPS and Big Island Wildfire Coordinating Group have cosponsored community wildfire protection plans, which have been developed by local communities in the vicinity of the park, outlining mitigation measures to reduce the chances of wildfires occurring (Laitinen 2006a, 2006b).

Many past, current, and future actions, plans, and programs at the park and in surrounding areas provide benefits for ethnographic resources. Natural resource and watershed protection on lands in and adjacent to the park has previously supported and will continue to support the protection of ethnographic resources by managing ingress of non-native ungulates into the park. Law enforcement activities would contribute to beneficial impacts by protecting ethnographic resources from being damaged by visitors who violate park rules and regulations. The future implementation of the GMP for the park will also involve prescriptions for desired conditions related to the protection of cultural resources, including ethnographic resources, balanced with those for visitor use. In addition, past acquisitions, such as Kahuku, and future acquisitions of new lands would contribute to the knowledge of ethnographic resources in the park. Future implementation of several management plans, including those in development—the GMP and the *Ala*

*Kahakai National Historic Trail Management Plan* (NPS n.d.a, 2004d) —would have long-term minor beneficial impacts on ethnographic resources because the plans contain mitigation measures for the protection of cultural and natural resources.

Increased past and present aviation activities have the potential to impact ethnographic resources. Viewsheds from sacred sites could be disrupted by noise and visual intrusion from aircraft overhead. The future implementation of the ATMP will likely help mitigate impacts on ethnographic resources. The ATMP would manage commercial aviation activities to specifically mitigate impacts on park resources.

These past, present, and reasonably foreseeable future actions would have both short- and long-term minor adverse impacts and short- and long-term minor to moderate beneficial impacts on ethnographic resources. When combined with the impacts of alternative A, there would be short- and long-term minor adverse cumulative impacts on ethnographic resources. Long-term benefits would be less likely under alternative A, because management would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

### **Conclusion**

Under alternative A, short-term minor adverse impacts on ethnographic resources would result from the implementation of management actions. In the older section of the park, long-term moderate to major beneficial impacts would result from the continuation of animal exclusion in managed units. However, long-term beneficial impacts would be unlikely for Kahuku and areas currently unmanaged (e.g., portions of ‘Ōla‘a), for which no established population-level objective and fencing strategy has been identified in a comprehensive and systematic plan. The effects of alternative A, when combined with impacts of past, present, and reasonably foreseeable future actions on ethnographic resources, would have short- and long-term minor adverse cumulative impacts. Long-term beneficial cumulative impacts would be less likely under alternative A, because management would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

### **Alternative B: Comprehensive Management Plan that Uses Lethal Removal Techniques**

#### **Analysis**

Alternative B would result in short-term minor adverse impacts to ethnographic resources. Monitoring, direct reduction with firearms, and fencing, would temporarily create noise from the use of helicopters and/or firearms that could affect cultural practitioners in the area. Temporary closures, due to control efforts, could also interfere with cultural practitioners. However, closures are usually for a few hours and rarely last more than a day. Also, management actions are typically confined to specific areas. Similarly, monitoring activities and fence construction involving the use of helicopters are also intermittent. Judging by past experience, closures would generally be used infrequently, and the public would be notified of them in advance so they can adjust their plans.

Ungulate control would support the protection and restoration of the native flora and fauna regarded as ethnographic resources to Native Hawaiians. Although Polynesian pigs were held in regard in Native Hawaiian legends, the European and other domestic strains of pigs have become the dominant type in the wild. These animals became feral and ventured into native forest where they proved destructive to the native flora. In the Hawaiian culture everything has a degree of sacredness, including the native plants,

birds, insects and the communities they form. In particular, upland plant communities are valued for supplying aquifers and providing the seed sources for forest regeneration.

During consultation meetings held with the Kupuna Consultation Group, one of the concerns voiced was that people should be able to hunt to put food on their table. Subsistence hunting has never been legal in the park. Although qualified volunteers participating in ground shooting would not be allowed to salvage meat, the NPS would salvage and donate meat when possible, following all applicable public health and government property guidelines. In addition, the park is surrounded by public hunting areas in state game and forest reserves that are used by the communities near the park.

Alternative B would result in short-term minor adverse impacts on ethnographic resources through implementation of management actions. Long-term moderate to major beneficial impacts resulting from the protection and recovery of native plants and animals valued as ethnographic resources would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative B would be the same as alternative A. The short- and long-term minor adverse impacts and short- and long-term minor beneficial impacts of past, present, and reasonably foreseeable future actions on ethnographic resources, when combined with the impacts of implementing alternative B, would have short- and long-term minor adverse and long-term moderate to major beneficial cumulative impacts. Long-term beneficial impacts would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Conclusion**

Under alternative B, short-term minor adverse impacts on ethnographic resources would result from the implementation of management actions. Long-term moderate to major beneficial impacts would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

The effects of alternative B, when combined with impacts of past, present, and reasonably foreseeable future actions on ethnographic resources, would have short- and long-term minor adverse and long-term moderate to major beneficial cumulative impacts.

## **Alternative C: Comprehensive Management Plan that Maximizes Efficiency by Expanding Lethal Removal Techniques and Discontinuing the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative C would result in short-term minor adverse impacts to ethnographic resources. Under this alternative, volunteers would not assist with animal removal efforts and meat would not be salvaged. However, there would continue to be opportunities to hunt in state and forest reserves

surrounding the park. Long-term moderate to major beneficial impacts resulting from the protection and recovery of native plants and animals valued as ethnographic resources would be fully realized under this alternative.

Because lethal techniques would be expanded and enhanced, and volunteers would not be used during direct reduction efforts under alternative C, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative B. The increased efficiency associated with discontinuing the use of volunteers is based on additional work required by NPS staff to recruit, administer, train and direct volunteers in the field, and data that show that park staff remove more ungulates per day when they conduct direct reduction (ground shooting) themselves, compared to when they are accompanied by volunteers (Stephens et al. 2008).

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative C would be the same as alternative A. Similar to alternative B, the short- and long-term minor adverse impacts and short- and long-term minor beneficial impacts of past, present, and reasonably foreseeable future actions on ethnographic resources, when combined with the impacts of implementing alternative C, would have short- and long-term minor adverse and long-term moderate to major beneficial cumulative impacts.

### **Conclusion**

Under alternative C, short-term minor adverse impacts on ethnographic resources would result from the implementation of management actions. Long-term moderate to major beneficial impacts would be fully realized under this alternative. The effects of alternative C, when combined with impacts of past, present, and reasonably foreseeable future actions on ethnographic resources, would have short- and long-term minor adverse and long-term moderate to major beneficial cumulative impacts.

## **Alternative D: Comprehensive Management Plan that Maximizes Flexibility of Management Techniques**

### **Analysis**

Similar to alternative B, alternative D would result in short-term minor adverse impacts to ethnographic resources. Long-term moderate to major beneficial impacts resulting from the protection and recovery of native plants and animals valued as ethnographic resources would be fully realized under this alternative.

Although the expansion and enhancement of lethal removal techniques under alternative D would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the continued use of volunteers and the expansion of non-lethal techniques would counteract this to some extent. Inclusion of non-lethal removal would require additional staff time and park resources to relocate animals to adjacent lands, and may increase the time associated with reduction actions over the life of the plan, as well as the time needed to reach the post-reduction phase. As a result, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative D would be the same as alternative A. Similar to alternative B, the short- and long-term minor adverse impacts and short- and long-term minor beneficial impacts of past, present, and reasonably foreseeable future actions on

ethnographic resources, when combined with the impacts of implementing alternative D, would have short- and long-term minor adverse and long-term moderate to major beneficial cumulative impacts.

### **Conclusion**

Under alternative D, short-term minor adverse impacts on ethnographic resources would result from the implementation of management actions. Long-term moderate to major beneficial impacts would be fully realized under this alternative. The effects of alternative D, when combined with impacts of past, present, and reasonably foreseeable future actions on ethnographic resources, would have short- and long-term minor adverse and long-term moderate to major beneficial cumulative impacts.

## **Alternative E: Comprehensive Management Plan that Increases Flexibility of Management Techniques While Limiting the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative E would result in short-term minor adverse impacts to ethnographic resources. Long-term moderate to major beneficial impacts resulting from the protection and recovery of native plants and animals valued as ethnographic resources would be fully realized under this alternative.

Although the expansion and enhancement of lethal removal techniques under alternative E would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the expansion of non-lethal techniques would counteract this to some extent. However, because volunteers would not be used during direct reduction efforts under alternative E, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative D, but less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative E would be the same as alternative A. Similar to alternative B, the short- and long-term minor adverse impacts and short- and long-term minor beneficial impacts of past, present, and reasonably foreseeable future actions on ethnographic resources, when combined with the impacts of implementing alternative E, would have long-term, minor, adverse and long-term, moderate to major beneficial cumulative impacts on ethnographic resources.

### **Conclusion**

Under alternative E, short-term minor adverse impacts on ethnographic resources would result from the implementation of management actions. Long-term moderate to major beneficial impacts would be fully realized under this alternative. The effects of alternative E, when combined with impacts of past, present, and reasonably foreseeable future actions on ethnographic resources, would have short- and long-term minor adverse and long-term moderate to major beneficial cumulative impacts.

## **ASSESSMENT OF EFFECT FOR NATIONAL HISTORIC PRESERVATION ACT SECTION 106**

After applying the Advisory Council's criteria of adverse effects (36 CFR 800.5, "Assessment of Adverse Effects") and receiving initial comments from the SHPO, the Office of Hawaiian Affairs, and from the Kupuna Consultation Group, the NPS has concluded the following assessment of effect for all alternatives.

### **Alternative A: No Action (Continue Existing Non-native Ungulate Management Activities)**

Construction of fencing could affect archeological resources; however, field surveys of proposed fence alignments would be conducted prior to construction and fences relocated to avoid archeological resources and to minimize disturbance to the cultural viewshed. Fences and ungulate removal would provide long-term benefits for cultural landscapes negatively impacted by non-native ungulates, but fences would also introduce new elements to park landscapes. Although management actions would reduce animal populations inside the park, there would be opportunities for the public to hunt in state game and forest reserves surrounding the park and on the island. In addition, opportunities for volunteers from the public to participate in ungulate removal and fence construction activities would continue. Control of ungulates would support protection of the native plants and animals valued in Hawaiian culture, which would have beneficial impacts on ethnographic resources. However, long-term beneficial impacts would be less likely under alternative A than under the action alternatives, because management would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

The NPS has determined that alternative A would have *no adverse effect* on archeological resources, cultural landscapes, and ethnographic resources in the park, as there would be no moderate or major modifications, ground-disturbing activities, or alterations made to known cultural resources, or alteration of resource conditions, traditional access, site preservation, or the relationship between the resource and the affiliated group's beliefs and practices.

### **Alternative B: Comprehensive Management Plan that Uses Lethal Removal Techniques**

Construction of fencing could affect archeological resources; however, field surveys of proposed fence alignments would be conducted prior to construction and fences relocated to avoid archeological resources. Fences and ungulate removal would provide long-term benefits for cultural landscapes negatively impacted by non-native ungulates, but fences would also introduce new elements to park landscapes. Although management actions would reduce animal populations inside the park, there would be opportunities for the public to hunt in state game and forest reserves surrounding the park and on the island. Opportunities for volunteers from the public to participate in ungulate removal and fence construction activities would continue. Although volunteers would not be able to keep the meat, the NPS would salvage and donate meat when possible, following all applicable public health and government property guidelines. Control of ungulates would support protection of the native plants and animals valued in Hawaiian culture and allow traditionally used native plant species to thrive, which would have beneficial impacts on ethnographic resources.

The NPS has determined that alternative B would have *no adverse effect* on archeological resources and cultural landscapes, and ethnographic resources in the park, as there would be no moderate or major modifications, ground-disturbing activities, or alterations made to known cultural resources, or alteration of resource conditions, traditional access, site preservation, or the relationship between the resource and the affiliated group's beliefs and practices.

### **Alternative C: Comprehensive Management Plan that Maximizes Efficiency by Expanding Lethal Removal Techniques and Discontinuing the Use of Volunteers**

Construction of fencing could affect archeological resources; however, actions would be located away from known sensitive cultural sites. The exact locations of boundary and enclosure fences would be determined during implementation, but it is assumed that the fences would have a long-term benefit from the preservation of endemic flora and fauna of the park, which contribute to cultural landscapes. Although

management actions would reduce animal populations inside the park, there would be opportunities for the public to hunt in state game and forest reserves surrounding the park and on the island. Control of ungulates would support protection of the native plants and animals valued in Hawaiian culture and allow traditionally used native plant species to thrive, which would have beneficial impacts on ethnographic resources.

The NPS has determined that alternative C would have *no adverse effect* on archeological resources and cultural landscapes, and ethnographic resources in the park, as there would be no moderate or major modifications, ground-disturbing activities, or alterations made to known cultural resources, or alteration of resource conditions, traditional access, site preservation, or the relationship between the resource and the affiliated group's beliefs and practices.

### **Alternative D: Comprehensive Management Plan that Maximizes Flexibility of Management Techniques**

Relocation activities could affect archeological resources; however, actions would be located away from known sensitive cultural sites. The exact locations of boundary and enclosure fences would be determined during implementation, but it is assumed that the fences would have a long-term benefit from the preservation of endemic flora and fauna of the park, which contribute to cultural landscapes. Although management actions would reduce animal populations inside the park, there would be opportunities for the public to hunt in state game and forest reserves surrounding the park and on the island. Opportunities for volunteers from the public to participate in ungulate removal and fence construction activities would continue. Although volunteers would not be able to keep the meat, the NPS would salvage and donate meat when possible, following all applicable public health and government property guidelines. Control of ungulates would support protection of the native plants and animals valued in Hawaiian culture and allow traditionally used native plant species to thrive, which would have beneficial impacts on ethnographic resources.

The NPS has determined that alternative D would have *no adverse effect* on archeological resources and cultural landscapes, and ethnographic resources in the park, as there would be no moderate or major modifications, ground-disturbing activities, or alterations made to known cultural resources, or alteration of resource conditions, traditional access, site preservation, or the relationship between the resource and the affiliated group's beliefs and practices.

### **Alternative E: Comprehensive Management Plan that Increases Flexibility of Management Techniques While Limiting the Use of Volunteers**

Relocation activities could affect archeological resources; however, actions would be located away from known sensitive cultural sites. The exact locations of boundary and enclosure fences would be determined during implementation, but it is assumed that the fences would have a long-term benefit from the preservation of endemic flora and fauna of the park, which contribute to cultural landscapes. Although management actions would reduce animal populations inside the park, there would be opportunities for the public to hunt in state game and forest reserves surrounding the park and on the island. Opportunities for volunteers from the public to participate in ungulate removal and fence construction activities would continue, although volunteers would not assist with ground shooting activities. Control of ungulates would support protection of the native plants and animals valued in Hawaiian culture and allow traditionally used native plant species to thrive, which would have beneficial impacts on ethnographic resources.

The NPS has determined that alternative E would have *no adverse effect* on archeological resources and cultural landscapes, and ethnographic resources in the park, as there would be no moderate or major

modifications, ground-disturbing activities, or alterations made to known cultural resources, or alteration of resource conditions, traditional access, site preservation, or the relationship between the resource and the affiliated group's beliefs and practices.

## WILDERNESS

### GUIDING REGULATIONS AND POLICIES

The *Wilderness Act*, passed on September 3, 1964, established a national wilderness preservation system, “administered for the use and enjoyment of the American people in such manner as will leave [these areas] unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness” (16 USC 1131). The *Wilderness Act* further defined wilderness as “an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, and which is protected and managed to preserve its natural conditions” (16 USC 1131). The *Wilderness Act* gives the agency managing the wilderness responsibility for preserving the wilderness character of the area and devoting the area to the public purposes of recreational, scenic, scientific, educational, conservation, and historical use (16 USC 1133). Certain uses are specifically prohibited, except for areas where these uses have already become established. The act states that “there shall be no commercial enterprise and no permanent road within any wilderness area designated by this chapter and except as necessary to meet minimum requirements for the administration of the area. . . . There shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area” (16 USC 1133).

Section 6.3.5 of NPS *Management Policies 2006* requires that all management decisions affecting wilderness must be consistent with the “minimum requirement” concept. This concept is a documented process used to determine whether administrative actions, projects, or programs undertaken by the NPS or its agents and affecting wilderness character, resources, or the visitor experience are necessary, and if so, how to minimize impacts (NPS 2006b). This analysis was conducted for all alternatives using the minimum requirements decision guide from the Arthur Carhart National Wilderness Training Center, and can be found in appendix B.

As described in Section 6.3.7 of NPS *Management Policies 2006*, “The principle of nondegradation will be applied to wilderness management. . . . Natural processes will be allowed, insofar as possible, to shape and control wilderness ecosystems. Management should seek to sustain the natural distribution, numbers, population composition, and interaction of indigenous species. Management intervention should only be undertaken to the extent necessary to correct past mistakes, the impacts of human use, and influences originating outside of wilderness boundaries” (NPS 2006b).

Director's Order 41: *Wilderness Preservation and Management* (NPS 1999c) was developed to provide accountability, consistency, and continuity to NPS wilderness management efforts and to otherwise guide NPS efforts in meeting the requirements set forth by the *Wilderness Act* of 1964.

Director's Order 41 sets forth guidance for applying the minimum requirement concept to protect wilderness and for the overall management, interpretation, and uses of wilderness. With regard to natural resource management in wilderness, it reaffirms management policies and states, “Management intervention should only be undertaken to the extent necessary to correct past mistakes, the impacts of human use, and the influences originating outside of wilderness boundaries” (NPS 1999c).

## METHODOLOGY, ASSUMPTIONS, AND IMPACT THRESHOLDS

In considering environmental impacts on wilderness, NPS *Management Policies 2006* requires that the analysis take into account (1) wilderness characteristics and values, including the primeval character and influence of the wilderness; (2) the preservation of natural conditions (including the lack of human-caused noise); and (3) assurances that there will be outstanding opportunities for solitude, that the public will be provided with a primitive and unconfined type of recreational experience, and that wilderness will be preserved and used in an unimpaired condition (NPS 2006b, Section 6.3.4.3).

The management actions in this plan may affect the untrammeled and undeveloped nature of the wilderness areas, but will not have any effect on the opportunity for visitors to enjoy primitive and unconfined forms of recreation.

Impact intensity thresholds were defined for adverse impacts. For this plan/EIS, assignment of intensity levels for wilderness impacts are based on the potential for changes to such characteristics as follows:

- Negligible:* There would be no discernible impact on opportunities for solitude. The natural character of wilderness and its untrammeled nature would not be affected.
- Minor:* There would be slight impacts on opportunities for solitude in limited areas of the wilderness. The natural character of wilderness or its untrammeled nature would not be noticeably affected.
- Moderate:* The opportunities for solitude would be noticeably reduced, in limited areas of the wilderness. The natural character of portions of the wilderness or its untrammeled nature could be noticeably affected.
- Major:* The opportunities for solitude would be substantially reduced, throughout the wilderness area. The natural character of wilderness or its untrammeled nature would be clearly altered on a large scale.

## IMPACTS OF THE ALTERNATIVES

### Alternative A: No Action (Continue Existing Non-native Ungulate Management Activities)

#### Analysis

Current management actions in wilderness areas include monitoring, removal of ingress animals, and fence maintenance and inspection. These actions would continue in existing non-native ungulate managed areas and could potentially expand to include fence construction and reduction activities in unmanaged areas of wilderness (e.g., portions of ‘Ōla‘a) and areas that may be considered for future wilderness designation (e.g., upper elevations of Kahuku).

For management units where animals have been excluded, disruptions to solitude by removal efforts do not occur frequently (see description in the “Elements Common to All Action Alternatives” section in chapter 2). Monitoring is done on foot or by helicopter. During monitoring, helicopters would be used in open vegetation areas, with a frequency of 3 to 4 times per year. These actions are typically conducted in the early morning to minimize impacts on visitors, and because the early morning is the optimal time for locating feral animals. In dense vegetation, monitoring is conducted on the ground via hiking, typically at 2-month intervals, during fence inspection activities. If non-native ungulates are identified, removal

actions, which could include trapping, snaring, and/or direct reduction with firearms, would be initiated. In forest, dense vegetation obscures and attenuates sound from these intrusions. It is assumed that removals, including those outside of wilderness, would occur approximately 5 to 20 times per year (spread out across the various units) when ingress is detected, and that some of these would require helicopter assistance. For areas where animal populations remain (e.g., portions of ‘Ōla‘a and upper elevations of Kahuku evaluated for wilderness eligibility), removal activities would initially be more frequent and then decrease once animals are excluded. The short-term human control or manipulation of ungulate populations, even though they are non-native, would affect the untrammelled nature of the wilderness areas. The use of helicopters would temporarily affect the undeveloped quality of the wilderness areas. The noise and presence of people would introduce sounds that are not part of the natural environment, and could disturb wildlife during implementation.

Maintaining a fence in wilderness would create a visual intrusion, and affect the undeveloped nature of the area. In open habitat, the presence of a fence would create a hazard for some species, such as native birds (petrels) and bats. Installation of fence posts in lava substrates may require using a motorized rock drill. Use of remote cameras may also introduce a modern element into the wilderness. Mitigation measures would be used to minimize impacts in wilderness areas. For example, fences are generally located away from visitor campsites and most trails, or are obscured by dense vegetation so that these intrusions are minimized. The areas affected visually by the fence would also be small relative to the large protected areas. The effects of introducing remote cameras could be mitigated by placing these in inconspicuous locations. The NPS would constantly evaluate fence design to minimize impacts, and would mitigate bird or bat fence strikes by using vinyl strips or flagging, by avoiding the use of barbed wire, and by placing fence in areas less likely to impact the petrels and bats. To minimize impacts on natural and cultural resources, fence alignments would be surveyed and rerouted to avoid cultural features and sensitive plant and animal species, and to avoid removal of large trees and rare plants. Fence work would be minimized or avoided in habitats of sensitive wildlife during the breeding seasons for these species.

The lack of suitable roads and terrain for stock animals in wilderness necessitates the use of helicopters for transport of fence material, equipment, tools, and camp supplies to fenced areas. Old fence material would be dismantled and hauled out by helicopter. For fence segments in more remote areas, a temporary administrative camp would be established for the duration of the repair work. All landings, drop sites, and temporary camps would be surveyed and placed to minimize impacts on surroundings. The use of the helicopter would minimize damage that would otherwise be caused by vehicles and pack animals traveling across lava surfaces and through dense vegetation. As determined by the Minimum Requirements Decision Guide, the use of pack animals is not practical, considering the large loads of fence material and equipment and the difficulty of traversing earth cracks and the highly uneven, fragile lava surfaces and dense vegetation off-trail. Such management activities would require vegetation clearing and leveling of surfaces along the travel routes, which would result in greater long-term adverse impacts than helicopter use.

The exclusion and removal of non-native ungulates would support recovery of natural conditions in wilderness, including the recovery of native plants and animals. Removal of ungulates would eliminate a source of mortality for sensitive native plants and remove a vector for non-native species dispersal.

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*The exclusion and removal of non-native ungulates would support recovery of natural conditions in wilderness, including the recovery of native plants and animals.*

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In summary, alternative A would result in short- and long-term minor to moderate adverse impacts to wilderness through fences, helicopter work and ground activities related to removal efforts and fence construction and maintenance. In the older section of the park, long-term beneficial impacts on wilderness through the recovery of

natural conditions would result from the continuation of animal exclusion in managed units. However, long-term benefits to the native vegetation would be unlikely for Kahuku (for which wilderness eligible areas are being considered) and areas currently unmanaged (e.g., portions of ‘Ōla‘a), for which no established population-level objective and fencing strategy has been identified. Also, the implementation of management tools and monitoring would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities. Because alternative A would not incorporate the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, it would be less likely that the NPS would progress through management phases, monitor, and apply management tools consistently as staff and institutional knowledge change over time.

### **Cumulative Impacts**

Various past, present, and reasonably foreseeable future actions would enhance wilderness and contribute to beneficial impacts on wilderness areas in the park. The completion and implementation of the GMP (which includes a wilderness study for the Kahuku Unit; in progress), and the future development of a wilderness management plan would address actions to be taken to sustain the natural and untrammelled condition of wilderness areas in the park, and will also include a wilderness eligibility assessment for the Kahuku District. The implementation of the fire management plan addresses the use of wildland fires and prescribed fires to restore natural characteristics of wilderness areas in the park. The acquisition of new lands (including Kahuku) could have beneficial impacts on wilderness, in that wilderness-like areas could potentially become legislated wilderness areas in the park.

There are also some past, current, and future actions that have contributed or would contribute to negligible to minor adverse cumulative effects on wilderness areas in the park. The installation of temporary instrumentation devices in wilderness areas has caused negligible to minor adverse impacts on the integrity of the wilderness areas in the park. The equipment includes GPS instrumentation, seismographs, climatology instrumentation, batteries, antennas, solar panels, and radio repeaters for research and to assist emergency operations. Several wilderness campsites include non-historic shelters, latrines, and catchments. Fragmentation and loss of habitat through non-native species invasions, development outside the park, and land management practices (including those outside the park) has altered the distribution and abundance of native plants and wildlife that contribute to natural character of wilderness. The change in the fire ecology and management for the island from habitat fragmentation and non-native species invasion has increased fire danger through the spread of various non-native plant species, which threatens the integrity and preservation of wilderness. Visitation at the park could also contribute to disturbances to wilderness by visitors trampling vegetation, disturbing wildlife, introducing human sounds, and reducing opportunities for solitude. While providing increased access and opportunities for visitor appreciation of wilderness areas, implementation of the *Ala Kahakai National Historic Trail Comprehensive Management Plan* and the proposed Mauna Loa trail system may also have short-term adverse impacts on wilderness due to noise and trampling associated with implementing these plans.

Increased overflights inside and outside the park, including those that are a result of volcanic activity and subsequent increased visitation, contribute to the impacts on the natural and quiet nature of wilderness, which can also impact wildlife living in wilderness. The park is working with the FAA to prepare an ATMP and EIS (FAA n.d.) with the objective of mitigating or preventing the significant adverse impacts, if any, of commercial air tour operations on the natural and cultural resources and visitor experiences of the park. This would offset some impacts of commercial air tours. Helicopters would continue to be used for administrative use above park lands, including wilderness, but due to the much lower frequency of administrative flights, these would contribute fewer adverse impacts to park resources compared to commercial overflights.

Some past, current, and future actions contribute to both beneficial and adverse impacts, depending on what stage of implementation they are in. For example, control of non-native species (e.g., plants and small non-native mammals) in wilderness would have short-term adverse impacts on wilderness due to vegetation trampling by staff and noise from equipment. However, these short-term impacts would have no overall effect on the ecological integrity of wilderness, and once activities are completed there would be long-term beneficial impacts. Similarly, the maintenance of trails in wilderness areas would have short-term adverse impacts on wilderness due to the presence of people and the disturbance caused by staff and associated equipment; however, once the maintenance is complete and the trails are improved, wilderness visitors would experience long-term beneficial impacts as a result of improved access in areas that provide solitude and primitive recreational experiences. The implementation of conservation actions outside the park, including USFWS recovery plans for sensitive species, would have short-term adverse impacts on wilderness as a result of NPS and USFWS staff entering areas adjacent to park wilderness and conducting management operations. However, the restoration of sensitive native species and habitat would contribute to long-term beneficial impacts on the natural character of adjacent park wilderness areas. The implementation of park management actions inside wilderness (including the use of boundary and interior fencing, fence inspection and repair, and vegetation and sensitive species restoration) has had adverse impacts on wilderness. But these actions would also have long-term beneficial impacts as a result of protection of the natural conditions of ecological integrity, biological diversity, and natural sounds (the latter caused by native birds and insects) that would occur across large areas of wilderness.

These past, present, and reasonably foreseeable future actions would have short-term and long-term minor to moderate adverse impacts on wilderness, as well as long-term beneficial effects. Actions such as staff trampling vegetation, overhead helicopter flights, and other park management operations in wilderness would have short-term adverse impacts and long-term beneficial impacts on wilderness, whereas fences would have both long-term adverse and long-term beneficial impacts on wilderness. Past, present, and reasonably foreseeable future actions, when combined with the impacts under alternative A, would result in short- and long-term minor to moderate adverse cumulative impacts on wilderness. Long-term beneficial impacts would be less likely under alternative A, because non-native ungulate management within the park would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

## **Conclusion**

Under alternative A, short- and long-term minor to moderate adverse impacts to wilderness would result from fences, helicopter work and ground activities related to removal efforts and fence construction and maintenance. In the older section of the park, long-term beneficial impacts on wilderness through the recovery of natural conditions would result from the continuation of animal exclusion in managed units. Long-term beneficial impacts would be unlikely for the Kahuku unit and areas currently unmanaged (e.g., portions of 'Ōla'a), where no established population-level objective or fencing strategy has been identified in a comprehensive and systematic plan. The effects of alternative A, when combined with impacts of past, present, and reasonably foreseeable future actions on wilderness, would have short- and long-term minor to moderate adverse cumulative impacts. Long-term beneficial cumulative impacts would be less likely under alternative A, because non-native ungulate management would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

## **Alternative B: Comprehensive Management Plan that Uses Lethal Removal Techniques**

### **Analysis**

For management units in the maintenance phase, disruptions to solitude by removal efforts do not occur frequently (see description in the “Elements Common to All Action Alternatives” section in chapter 2). Monitoring is done on foot or by helicopter. During monitoring, helicopters would be used in open vegetation areas, with a frequency of 3 to 4 times per year. These actions are typically conducted in the early morning to minimize impacts on visitors, and because the early morning is the optimal time for locating feral animals. In dense vegetation, monitoring is conducted on the ground via hiking, typically at 2-month intervals, during fence inspection activities. If non-native ungulates are identified in these maintenance areas, removal actions, which could include trapping, snaring, and/or direct reduction with firearms, would be initiated. In forest, dense vegetation obscures and attenuates sound from these intrusions. It is assumed that removals associated with the maintenance phase of management, including those outside of wilderness, would occur approximately 5 to 20 times per year (spread out across the various units) when ingress is detected, and that some of these would require helicopter assistance. For areas in the reduction and post-reduction phases (e.g., portions of ‘Ōla‘a and upper elevations of Kahuku evaluated for wilderness eligibility), removal activities would initially be more frequent and then decrease once animals are excluded. The short-term human control or manipulation of ungulate populations, even though they are non-native, would affect the untrammelled nature of the wilderness areas. The use of helicopters would temporarily affect the undeveloped quality of the wilderness areas. The noise and presence of people would introduce sounds that are not part of the natural environment, and could disturb wildlife during implementation.

Maintaining a fence in wilderness would create a visual intrusion, and affect the undeveloped nature of the area. In open habitat, the presence of a fence would create a hazard for some species, such as native birds (petrels) and bats. Installation of fence posts in lava substrates may require using a motorized rock drill. Use of remote cameras may also introduce a modern element into the wilderness. Mitigation measures would be used to minimize impacts in wilderness areas. For example, fences are generally located away from visitor campsites and most trails, or are obscured by dense vegetation so that these intrusions are minimized. The areas affected visually by the fence would also be small relative to the large protected areas. The effects of introducing remote cameras could be mitigated by placing these in inconspicuous locations. The NPS would constantly evaluate fence design to minimize impacts, and would mitigate bird or bat fence strikes by using vinyl strips or flagging, by avoiding the use of barbed wire, and by placing fence in areas least likely to impact the petrels and bats. To minimize impacts on natural and cultural resources, fence alignments would be surveyed and rerouted to avoid cultural features and sensitive plant and animal species, and to avoid removal of large trees and rare plants. Fence work would be minimized or avoided in habitats of sensitive wildlife during the breeding seasons for these species.

The lack of suitable roads and terrain for stock animals in wilderness necessitates the use of helicopters for transport of fence material, equipment, tools, and camp supplies to fenced areas. Old fence material would be dismantled and hauled out by helicopter. For fence segments in more remote areas, a temporary administrative camp would be established for the duration of the repair work. All landings, drop sites, and temporary camps would be surveyed and placed to minimize impacts on surroundings. The use of the helicopter would minimize damage that would otherwise be caused by vehicles and pack animals traveling across lava surfaces and through dense vegetation. As determined by the Minimum Requirements Decision Guide, the use of pack animals is not practical, considering the large loads of fence material and equipment and the difficulty of traversing earth cracks and the highly uneven, fragile lava surfaces and dense vegetation off-trail. Such management activities would require vegetation

clearing and leveling of surfaces along the travel routes, which would result in more long-term adverse impacts than helicopter use.

The exclusion and removal of non-native ungulates would support recovery of natural conditions in wilderness, including the recovery of native plants and animals. Removal of ungulates would eliminate a source of mortality for sensitive native plants and remove a vector for non-native species dispersal.

In summary, alternative B would result in short- and long-term minor to moderate adverse impacts to wilderness through fences. Long-term beneficial impacts to wilderness through exclusion of non-native ungulates and supporting recovery of natural conditions would be fully realized under alternative B because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative B would be the same as alternative A. The short- and long-term minor to moderate adverse and long-term beneficial impacts of past, present, and reasonably foreseeable future actions on wilderness, when combined with the impacts of implementing alternative B, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts. Long-term beneficial impacts to wilderness through exclusion of non-native ungulates and supporting recovery of natural conditions would be fully realized under alternative B because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Conclusion**

Under alternative B, short- and long-term minor to moderate impacts on wilderness would result from fences, helicopter work and ground activities related to removal efforts and fence construction and maintenance. Long-term beneficial impacts to wilderness would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

The effects of alternative B, when combined with impacts of past, present, and reasonably foreseeable future actions on wilderness, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

## **Alternative C: Comprehensive Management Plan that Maximizes Efficiency by Expanding Lethal Removal Techniques and Discontinuing the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative C would result in short- and long-term minor to moderate adverse impacts to wilderness through use of fences, helicopter work and ground activities related to removal efforts and fence construction and maintenance. Long-term beneficial impacts to wilderness through exclusion of non-native ungulates and supporting recovery of natural conditions would be fully realized under alternative C.

Because lethal techniques would be expanded and enhanced, and volunteers would not be used during direct reduction efforts under alternative C, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative B. The increased efficiency associated with discontinuing the use of volunteers is based on additional work required by NPS staff to recruit, administer, train and direct volunteers in the field, and data that show that park staff remove more ungulates per day when they conduct direct reduction (ground shooting) themselves, compared to when they are accompanied by volunteers (Stephens et al. 2008). Therefore, fewer reduction activities would result when compared to alternative B.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative C would be the same as alternative A. Similar to alternative B, the long-term beneficial and short-term and long-term minor to moderate adverse impacts of past, present, and reasonably foreseeable future actions on wilderness, when combined with the impacts of implementing alternative C, would have long-term beneficial and short- and long-term minor to moderate adverse cumulative impacts.

### **Conclusion**

Under alternative C, short- and long-term minor to moderate impacts on wilderness would result from fences, helicopter work and ground activities related to removal efforts and fence construction and maintenance. Long-term beneficial impacts to wilderness would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative C than under alternative B. The effects of alternative C, when combined with impacts of past, present, and reasonably foreseeable future actions on wilderness, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

## **Alternative D: Comprehensive Management Plan that Maximizes Flexibility of Management Techniques**

### **Analysis**

Similar to alternative B, alternative D would result in short- and long-term minor to moderate adverse impacts to wilderness through use of fences, helicopter work and ground activities related to removal efforts and fence construction and maintenance. Long-term beneficial impacts to wilderness through exclusion of non-native ungulates and supporting recovery of natural conditions would be fully realized under alternative D.

Under alternative D, it is possible that increased human and helicopter traffic associated with potential relocation activities could cause additional disturbance to wilderness during the process of driving animals to adjacent lands. However, these impacts would be short-term and localized, and similar to impacts of other management actions.

Although the expansion and enhancement of lethal removal techniques under alternative D would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the continued use of volunteers and the expansion of non-lethal techniques would counteract this to some extent. Inclusion of non-lethal removal would require additional staff time and park resources to relocate animals to adjacent lands, and may increase the time associated with reduction actions over the life of the plan, as well as time needed to reach the post-reduction phase. As a result, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative D would be the same as alternative A. Similar to alternative B, the short- and long-term minor to moderate adverse impacts and long-term beneficial impacts of past, present, and reasonably foreseeable future actions on wilderness, when combined with the impacts of implementing alternative D, would have long-term beneficial and short- and long-term minor to moderate adverse cumulative impacts.

### **Conclusion**

Under alternative D, short- and long-term minor to moderate impacts on wilderness would result from fences, helicopter work and ground activities related to removal efforts and fence construction and maintenance. Long-term beneficial impacts to wilderness would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly under alternative D than under alternative C. The effects of alternative D, when combined with impacts of past, present, and reasonably foreseeable future actions on wilderness, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

### **Alternative E: Comprehensive Management Plan that Increases Flexibility of Management Techniques While Limiting the Use of Volunteers**

#### **Analysis**

Similar to alternative B, alternative E would result in short- and long-term minor to moderate adverse impacts to wilderness through use of fences, helicopter work and ground activities related to removal efforts and fence construction and maintenance. Long-term beneficial impacts to wilderness through exclusion of non-native ungulates and supporting recovery of natural conditions would be fully realized under alternative E.

Similar to alternative D, it is possible that potential relocation activities could cause additional disturbance to wilderness during the process of driving animals to adjacent lands under alternative E.

Although the expansion and enhancement of lethal removal techniques under alternative E would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the expansion of non-lethal techniques would counteract this to some extent. However, because volunteers would not be used during direct reduction efforts under alternative E, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative D, but less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative E would be the same as alternative A. Similar to alternative B, the short- and long-term minor to moderate adverse impacts and long-term beneficial impacts of past, present, and reasonably foreseeable future actions on wilderness, when combined with the impacts of implementing alternative E, would have long-term beneficial and short- and long-term minor to moderate adverse cumulative impacts.

### **Conclusion**

Under alternative E, short- and long-term minor to moderate impacts on wilderness would result from fences, helicopter work and ground activities related to removal efforts and fence construction and

maintenance. Long-term beneficial impacts to wilderness would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative E than under alternative D, but less quickly than under alternative C. The effects of alternative E, when combined with impacts of past, present, and reasonably foreseeable future actions on wilderness, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

## SOILS

### GUIDING REGULATIONS AND POLICIES

In supporting federal and state regulations, the NPS *Management Policies 2006* states that the NPS will actively seek to understand and preserve the soil resources of parks, and prevent, to the extent possible, the unnatural erosion, physical removal, or contamination of the soil or its contamination of other resources (NPS 2006b, Section 4.8.2.4).

### METHODOLOGY, ASSUMPTIONS, AND IMPACT THRESHOLDS

Impact intensities for soils were derived from the available soils information and park staff observations of the effects on soils from compaction and loss of vegetation due to browsing and trampling by non-native ungulates. Within the park, impacts on soils include increased erosion, compaction, and nonpoint-source runoff related to the removal of vegetation.

Impact intensity thresholds were defined for adverse impacts. For this plan/EIS, assignment of intensity levels for soil impacts are based on the potential for changes to such characteristics as follows:

- Negligible:* The impact is not detectable or measurable and causes very little or no physical disturbance, compaction, or unnatural erosion when compared with current conditions.
- Minor:* The impact is slight but detectable in some areas, with few perceptible effects of physical disturbance, compaction, or unnatural erosion of soils.
- Moderate:* The impact is readily apparent and has measurable effects of physical disturbance, compaction, or unnatural erosion of soils.
- Major:* The impact is readily apparent and has severe effects of physical disturbance, compaction, or unnatural erosion of soils.

### IMPACTS OF THE ALTERNATIVES

#### Alternative A: No Action (Continue Existing Non-native Ungulate Management Activities)

##### Analysis

Impacts on soils would be limited to those associated with temporary ground-based management actions (e.g., the presence of humans placing bait stations, shooting ungulates, setting traps and snares, and monitoring and collecting data, as well as constructing and repairing fences), including foot traffic. Impacts would include those associated with any routine field activity, including temporary increases in soil compaction and possible erosion. Fencing would involve minor soil disturbances and trampling of

any vegetation in the removal areas. The NPS would continue to pursue safe and effective non-toxic alternatives to the use of lead bullets. As part of direct reduction activities, trained dogs could be used to locate and flush or immobilize non-native ungulates to facilitate direct reduction from the ground (or from the air). Impacts on soils from these activities would be similar to those associated with routine field activities and would not have noticeable effects on soils. The duration and frequency of these actions would also decrease as the park moves from reduction into less intensive management phases. As a result, there would short-term, localized negligible adverse impacts on soils during management actions.

Removal of non-native ungulates would limit the threats they pose and would support recovery and restoration of soils. Soil disturbance results from digging by feral pigs or general disturbance related to non-native ungulates, such as removal of vegetation as a result of grazing by large numbers of goats, sheep, and mouflon. Heavy, sustained use by ungulates can weaken or kill vegetation, reduce soil cover, and thereby contribute to and accelerate surface erosion (USFWS n.d.). This is especially true in areas with steep slopes, along water flow paths, and in areas exposed to wind. Increased erosion also has the potential to decrease soil fertility. Consequently, reduction of ungulate browsing would eliminate a source of soil compaction and erosion. Improvements in native vegetation, including ground cover, would further reduce soil erosion potential.

In summary, alternative A would result in short-term, localized negligible adverse impacts to soils through ground-based management actions. In the older section of the park, long-term beneficial impacts on soil would result from the continuation of animal exclusion in current management units. However, long-term benefits to soil would be unlikely for Kahuku and unmanaged portions of 'Ōla'a, for which no established population-level objective and fencing strategy has been identified. Also, the implementation of management tools and monitoring would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities. Because alternative A would not incorporate the comprehensive, systematic approach described in the "Elements Common to All Action Alternatives" section in chapter 2, it would be less likely that the NPS would progress through management phases, monitor, and apply management tools consistently as staff and institutional knowledge change over time.

### **Cumulative Impacts**

Other past, present, and future actions in the areas adjacent to the park have affected or could affect soils. In particular, adverse effects have occurred and continue to occur from the introduction of non-native plant species and associated changes in the fire regime on the island. These plants and the fires they help create can reduce native vegetation cover, which contributes to erosion and loss of soil productivity. Past ranching activities in the park have also led to loss of vegetation and similar impacts on soils. Other actions that have caused or could cause increased soil loss or compaction include increased visitation and development inside the park, including development and maintenance of facilities, fences, and trails.

Other park management plans and actions, such as the fire management plan (NPS 2005a), contribute beneficially to soil resources. Fire management actions are designed to reduce the risk of fire caused by fire-promoting grasses, which provides an indirect benefit to soils (fewer fires mean less erosion), enhancing soil stability. The future implementation of the GMP for the park (currently in development) would also involve prescriptions for desired conditions related to the protection of natural resources balanced with those for visitor use, which is expected to increase as a result of increased tourism in the area. Effective non-native ungulate management in areas adjacent to the park would limit soil disturbance and allow for the recovery of native vegetation, which contributes to soil stability and productivity along park boundaries. Revegetation and sensitive species restoration activities (including USFWS recovery plans) would also contribute to such benefits. Law enforcement activities would contribute to beneficial impacts by protecting vegetation from being disturbed or displaced (which contributes to erosion and loss

of soil productivity) by visitors who violate park rules and regulations, but would also contribute to localized minor adverse impacts should law enforcement officials need to conduct activities that could disturb vegetation (contributing to accelerated erosion and soil disturbance).

The acquisition of the Kahuku unit resulted in the increased protection of natural resources on these lands, including soils, due to implementing management actions under the interim operating plan that were not previously being implemented. The TMA partnership focuses on watershed protection efforts and providing important habitat for native species on thousands of acres, including areas adjacent to the park. Natural resource and watershed protection on lands in and adjacent to the park has previously supported and will continue to support the protection and recovery of native vegetation, which contributes to soil stability. Areas adjacent to the park that are not managed for the conservation of native vegetation will likely continue to degrade due to the uncontained spread of invasive species.

These past, present, and reasonably foreseeable future actions would have short-term and long-term minor to moderate adverse and long-term beneficial impacts on soils. When combined with the impacts under alternative A, there would be short- and long-term minor to moderate adverse cumulative impacts on vegetation. Long-term beneficial cumulative impacts would be less likely under alternative A, because non-native ungulate management within the park would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

### **Conclusion**

Under alternative A, short-term, localized negligible adverse impacts to soils would result from ground-based management actions. In the older section of the park, long-term beneficial impacts on soil would result from the continuation of animal exclusion in current management units. Long-term beneficial impacts would be unlikely for the Kahuku unit and unmanaged portions of ‘Ōla‘a, where no established population-level objective or fencing strategy has been identified in a comprehensive and systematic plan.

The effects of alternative A, when combined with impacts of past, present, and reasonably foreseeable future actions on soil, would have short- and long-term minor to moderate adverse cumulative impacts. Long-term beneficial cumulative impacts would be less likely under alternative A, because non-native ungulate management would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

### **Alternative B: Comprehensive Management Plan that Uses Lethal Removal Techniques**

#### **Analysis**

Impacts to soils under alternative B would be limited to those associated with temporary ground-based management actions (including the presence of humans on foot, placing bait stations, shooting ungulates, setting traps and snares, monitoring and collecting data, constructing and repairing fences, and using dogs). Impacts would include those associated with any routine field activity, including temporary increases in soil compaction and possible erosion. Fencing would involve minor soil disturbances and trampling of any vegetation in the removal areas. The NPS would continue to pursue safe and effective non-toxic alternatives to the use of lead bullets. As part of direct reduction activities, trained dogs could be used to locate and flush or immobilize non-native ungulates to facilitate direct reduction from the ground (or from the air). Impacts on soils from these activities would be similar to those associated with

routine field activities and would not have noticeable effects on soils. The duration and frequency of these actions would also decrease as the park moves from reduction into less intensive management phases. As a result, there would short-term, localized negligible adverse impacts on soils during management actions.

Removal of non-native ungulates would limit the threats they pose and would support recovery and restoration of soils. Soil disturbance results from digging by feral pigs or general disturbance related to non-native ungulates, such as removal of vegetation as a result of grazing by large numbers of goats, sheep, and mouflon. Heavy, sustained use by ungulates can weaken or kill vegetation, reduce soil cover, and thereby contribute to and accelerate surface erosion (USFWS n.d.). This is especially true in areas with steep slopes, along water flow paths, and in areas exposed to wind. Increased erosion also has the potential to decrease soil fertility. Consequently, reduction of ungulate browsing would eliminate a source of soil compaction and erosion. Improvements in native vegetation, including ground cover, would further reduce soil erosion potential.

As a result, under alternative B there would short-term, localized negligible adverse impacts on soils during management actions. Removal of non-native ungulates would limit the threats they pose to soils, resulting in long-term beneficial impacts. These benefits would be fully realized under alternative B because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative B would be the same as alternative A. The long-term beneficial and short-term and long-term minor to moderate adverse impacts of past, present, and reasonably foreseeable future actions on soils, when combined with the impacts of implementing alternative B, would have long-term beneficial and short- and long-term minor to moderate adverse cumulative impacts. These benefits would be fully realized under alternative B because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Conclusion**

Under alternative B, short-term, localized negligible adverse impacts to soils would result from ground-based management actions. Long-term beneficial impacts to soils would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

The effects of alternative B, when combined with impacts of past, present, and reasonably foreseeable future actions on soil, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

## **Alternative C: Comprehensive Management Plan that Maximizes Efficiency by Expanding Lethal Removal Techniques and Discontinuing the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative C would result in short-term, localized negligible adverse impacts to soils from ground-based management actions. Long-term beneficial impacts to soils would be fully realized under alternative C.

Because lethal techniques would be expanded and enhanced, and volunteers would not be used during direct reduction efforts under alternative C, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative B. The increased efficiency associated with discontinuing the use of volunteers is based on additional work required by NPS staff to recruit, administer, train and direct volunteers in the field, and data that show that park staff remove more ungulates per day when they conduct direct reduction (ground shooting) themselves, compared to when they are accompanied by volunteers (Stephens et al. 2008). Therefore, fewer reduction activities would result when compared to alternative B.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative C would be the same as alternative A. Similar to alternative B, the long-term beneficial and short-term and long-term minor to moderate adverse impacts of past, present, and reasonably foreseeable future actions on soils, when combined with the impacts of implementing alternative C, would have long-term beneficial and short- and long-term minor to moderate adverse cumulative impacts on soils.

### **Conclusion**

Under alternative C, short-term, localized negligible adverse impacts to soils would result from ground-based management actions. Long-term beneficial impacts to soils would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative C than under alternative B. The effects of alternative C, when combined with impacts of past, present, and reasonably foreseeable future actions on soil, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

## **Alternative D: Comprehensive Management Plan that Maximizes Flexibility of Management Techniques**

### **Analysis**

Similar to alternative B, alternative D would result in short-term, localized negligible adverse impacts to soils from ground-based management actions. Long-term beneficial impacts to soils would be fully realized under alternative D.

Under alternative D, it is possible that increased human and vehicular traffic associated with potential relocation activities could cause additional disturbance to soils during the process of driving animals to adjacent lands. However, these impacts would be short-term and localized, and similar to impacts of other management actions.

Although the expansion and enhancement of lethal removal techniques under alternative D would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management,

the continued use of volunteers and the expansion of non-lethal techniques would counteract this to some extent. Inclusion of non-lethal removal would require additional staff time and park resources to relocate animals to adjacent lands, and may increase the time associated with reduction actions over the life of the plan, as well as time needed to reach the post-reduction phase. As a result, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative D would be the same as alternative A. Similar to alternative B, the long-term beneficial and short-term and long-term minor to moderate adverse impacts of past, present, and reasonably foreseeable future actions on soils, when combined with the impacts of implementing alternative D, would have long-term beneficial and short- and long-term minor to moderate adverse cumulative impacts on soils.

### **Conclusion**

Under alternative D, short-term, localized negligible adverse impacts to soils would result from ground-based management actions. Long-term beneficial impacts to soils would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly under alternative D than under alternative C. The effects of alternative D, when combined with impacts of past, present, and reasonably foreseeable future actions on soil, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

## **Alternative E: Comprehensive Management Plan that Increases Flexibility of Management Techniques While Limiting the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative E would result in short-term, localized negligible adverse impacts to soils from ground-based management actions. Long-term beneficial impacts to soils would be fully realized under alternative E.

Similar to alternative D, it is possible that potential relocation activities could cause additional disturbance to soils during the process of driving animals to adjacent lands under alternative E.

Although the expansion and enhancement of lethal removal techniques under alternative E would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the expansion of non-lethal techniques would counteract this to some extent. However, because volunteers would not be used during direct reduction efforts under alternative E, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative D, but less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative E would be the same as alternative A. Similar to alternative B, the long-term beneficial and short-term and long-term minor to moderate adverse impacts of past, present, and reasonably foreseeable future actions on soils, when combined with the impacts of implementing alternative E, would have long-term beneficial and short- and long-term minor to moderate adverse cumulative impacts on soils.

## Conclusion

Under alternative E, short-term, localized negligible adverse impacts to soils would result from ground-based management actions. Long-term beneficial impacts to soils would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative E than under alternative D, but less quickly than under alternative C. The effects of alternative E, when combined with impacts of past, present, and reasonably foreseeable future actions on soil, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

## SOUNDSCAPES

### GUIDING REGULATIONS AND POLICIES

The NPS *Organic Act* (16 USC 1) establishes and authorizes the NPS “to conserve the scenery and the national and historic objects and 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” (NPS 2009g). An important part of the ecological communities that the NPS wishes to preserve in national parks is the natural soundscape. Thus, there are many laws, regulations, and policies that guide the protection and management of natural soundscapes.

These laws cover several aspects of sound, including air tour management and overflights, visitor use, motorized equipment, and soundscape management.

Regarding general park soundscape management, NPS *Management Policies 2006*, Section 4.9, requires that the NPS “preserve, to the greatest extent possible, the natural soundscapes of parks.” Additionally, the NPS “will restore to the natural condition wherever possible those park soundscapes that have become degraded by the unnatural sounds (noise), and will protect natural soundscapes from unacceptable impacts” (NPS 2006b). Additionally, Director’s Order 47: *Soundscape Preservation and Management* (NPS 2000) was developed to emphasize NPS policies “that will require, to the fullest extent practicable, the protection, maintenance, or restoration of the natural soundscape resource in a condition unimpaired by inappropriate or excessive noise sources.” This director’s order also directs park managers to measure acoustic conditions, differentiate existing or proposed human-caused sounds that are consistent with park purposes, set acoustic goals based on the sounds deemed consistent with the park purpose, and determine which noise sources are impacting the parks.

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Primarily as a result of the growth of the air tour industry, the number of airplane and helicopter flights over national parks has increased. Consequently, in the 1990s Congress mandated the FAA and the NPS to manage air tours over parks to ensure that park resources do not suffer any loss of value due to air tour activities. As such, the *National Parks Air Tour Management Act* of 2000 requires the development of commercial ATMPs (NPS 2003b). Further, *NPS Management Policies 2006*, Section 8.4, mandates that all necessary steps be taken to avoid or mitigate adverse effects from aircraft overflights in order to reduce adverse effects on resources and visitor enjoyment (NPS 2006b).

## METHODOLOGY, ASSUMPTIONS, AND IMPACT THRESHOLDS

The methodology used to assess impacts on the natural soundscape from the management of non-native ungulates in Hawai‘i Volcanoes National Park is consistent with NPS *Management Policies 2006* and Director’s Order 47: *Soundscape Preservation and Noise Management* (NPS 2006b, 2000). The policies require the type, magnitude, duration, and frequency of occurrence of noise to be determined for the affected environment, as well as the significance of noise levels or impacts.

In addition to the impacts of noise on the soundscape in general, noise intrusions can impact specific resources in the park. The Hawai‘i Volcanoes National Park resources most likely to be affected by management activities include the park’s natural soundscape, wilderness areas, cultural resources, and noise-sensitive wildlife, primarily birds. These potential impacts are discussed in this plan/EIS under their respective impact topics—for example, impacts of noise on wildlife are discussed under “Native Wildlife and Wildlife Habitat” and impacts of noise on visitors are discussed under “Visitor Use and Experience.” Analysis in this section is intended to disclose impacts on the natural soundscape in general, recognizing that sound is an intrinsic part of other resources and values at Hawai‘i Volcanoes National Park.

The primary elements associated with the management of non-native ungulates that may result in intrusions of noise on the natural soundscape include the use of vehicles, helicopters, and firearms in addition to gas generators, pneumatic post drivers, and rock drills for the construction and/or maintenance of fencing. Impacts were evaluated using the following assumptions and published information about vehicular, firearm, helicopter, and construction equipment noise, as well as data obtained from earlier acoustic measurements at Hawai‘i Volcanoes National Park. Additionally, consideration was given to the frequency and duration of management activities, as discussed in chapter 2. The impact analysis area for soundscapes includes the entire park as defined by 10 acoustic sampling areas for which the earlier acoustic measurements were conducted as part of the development of the Hawai‘i Volcanoes National Park ATMP. See appendix D for complete descriptions of acoustic sampling area information. No additional sound measurements were collected, nor was any noise modeling conducted.

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Noise levels generated by vehicular sources vary by the volume of the traffic, the speed of the traffic, and the number of vehicles contributing to the volume. Typically, the loudness of traffic noise is increased by heavier traffic volumes, higher speeds, and greater numbers of trucks (FHWA 1995). Additionally, inclines cause greater laboring of vehicle engines, thereby resulting in increased traffic noise levels, especially for heavy trucks. However, as the distance from the vehicular source increases, noise levels are affected by terrain features, human-made obstacles, vegetation, and the distance from the source in general. Typically, noise levels drop off at a rate of 3 dBA per doubling of distance from the vehicular sound source (FHWA 1995). In Hawai‘i Volcanoes National Park, it is assumed that vehicles used for the management of non-native ungulates would be traveling at very low speeds, as park roadway speed limits range between 15 and 35 miles per hour (NPS 2008c).

Noise levels generated by firearms are highly dependent on the type of firearm as well as the ammunition used. For example, a comparison of shotgun noise data with centerfire rifle noise level data and centerfire pistol data reveal a range of sound levels from 150 to 170 decibels. Although these noise levels are extremely high, the explosive shockwave that emanates from the gun barrel (referred to as the muzzle blast) usually lasts 3 to 5 milliseconds and is strongest in the direction the barrel is pointing (Maher

2006). The acoustic wave associated with the muzzle blast propagates through the air, encountering meteorological and topographical features that alter the sound received at greater distances from the firearm (Maher 2007).

For the purposes of analyzing impacts from helicopters, it is assumed that flight paths could potentially cover the entire park; however, the degree of disturbance to the soundscape caused by the overflights is influenced by numerous factors, including the height AGL, the speed at which the helicopters fly, flight duration, frequency of flights, the percentage of time when only the natural soundscape is audible, and the time between flights. These are some of the measures that will be used to quantify disturbance or noise impacts on park resources for this NEPA analysis. It is assumed that a Hughes 500C helicopter, flying approximately 300 feet (91 meters) AGL, will be used for aerial assistance. Sound exposure levels for reasonable level flyover (LFO) speeds ranging from 60 to 130 knots, as well as a maximum noise level ( $L_{\max}$ <sup>3</sup> value), were calculated based on best available information contained in the FAA report entitled *Helicopter Noise Exposure Curves for Use in Environmental Impact Assessment, November 1982*. The report depicts noise power distance curves for LFOs at speeds ranging between 60 and 130 knots, which account for how the noise power produced by the helicopter is changing with airspeed. The actual sound exposure level was computed based on applying an adjustment factor to the values obtained from the curves to account for the noise event duration change as the helicopter speed changes. The appropriate adjustment factors for each LFO were computed using the equation and applicable values for a Hughes 500C helicopter given in table 4.5-1 of the FAA report (FAA 1982). Sound exposure levels for LFOs ranging between 60 and 130 knots are depicted in table 22. The  $L_{\max}$  value for 300 feet (91 meters) AGL was computed based on figure 4.4-1 in the FAA report, which depicts  $L_{\max}$  values for several helicopters at 400 feet (122 meters) AGL for various glideslope angles.<sup>4</sup> A standard logarithmic equation, accounting for spherical spreading from a point source at a rate of 6 dBA per doubling or halving of distance, was applied to determine the  $L_{\max}$  value at 300 feet (91 meters) AGL (CALTRANS 1998).<sup>5</sup>

**TABLE 22: HUGHES 500C LEVEL FLYOVER SOUND EXPOSURE LEVELS**

LFO Speed (knots)	LFO SEL (dBA)
60	88.98
80	85.72
100	85.22
120	87.98
130	91.52

SEL = sound exposure levels.

<sup>3</sup> The SEL and  $L_{\max}$  were computed, as these are both values computed by the FAA's Integrated Noise Model, which is designed for modeling aircraft noise.

<sup>4</sup> For purposes of identifying the  $L_{\max}$  from the chart, a zero-degree glideslope angle was assumed applicable to a LFO condition.

<sup>5</sup> The logarithmic equation used to compute geometric divergence, also known as spherical spreading, is given by:

$$dBA2 = dBA1 + 20 * \log_{10}(D1/D2)$$

where

$$\begin{aligned} dBA1 &= \text{known reference noise level} \\ D1 &= \text{reference distance at which noise level (dBA1) is known} \\ D2 &= \text{distance at which noise level is desired} \\ dBA2 &= \text{calculated noise level at desired distance (D2)} \end{aligned}$$

Construction equipment, including rock drills, gasoline generators, and pneumatic post drivers, that would potentially be used for the construction and/or maintenance of boundary fences would generate noise. The Federal Highway Administration's roadway construction noise model contains a list of the maximum noise levels ( $L_{max}$ ) produced by common construction equipment at a distance of 50 feet, as listed in the equipment specifications. According to this list, the  $L_{max}$  at 50 feet (15 meters) from a rock drill and typical pneumatic tools is 85 dBA. The maximum noise emission level produced by a gasoline generator is dependent on several factors, including the size of the generator, whether or not it is equipped with mufflers, and the horsepower rating. Generally, given the fact that these boundary fences are or would be installed in remote locations, it is likely that the generator used to power the pneumatic post driver and rock drill for fence installment would be small. The main noise contributors from fence maintenance and construction would be the pneumatic post driver and rock drill. The generator noise would likely be inaudible during use of the rock drill and pneumatic post driver, although the noise from the generator would contribute to the overall sound level produced. Further, as the construction equipment used for fence installation may be thought of as point sources of noise, the radiation pattern is such that the noise level will drop off at a rate of 6 dBA per doubling of distance from the source (CALTRANS 1998). However, additional attenuation would be realized at distances from the equipment source due to vegetation and topography.

Thresholds were formulated for identifying soundscape impacts for use throughout the park as indicators of the magnitude of impact for each of the alternatives. Noise levels in the thresholds were selected qualitatively by describing them as very low, low, medium, and high (see table 10 in chapter 3). Impact intensity thresholds were defined for adverse impacts. For this plan/EIS, assignment of intensity levels for soundscape impacts are based on the potential for changes to such characteristics as follows:

- Negligible:* Natural sounds are audible and discernible, although human-caused noise may be audible very infrequently in local areas. When noise is present, it is at very low levels (mostly not measurable), passing, and rarely audible from a distance.
- Minor:* Natural sounds are audible and discernible, although human-caused noise is present occasionally in local areas. When noise is present, it is at measurable but low levels, passing, and rarely audible at a distance.
- Moderate:* Human-caused noise is present occasionally across most of an area. When present, it is at medium levels that may mask natural sounds briefly, and may be audible at a distance. High noise levels may occur, but would be very brief in duration.
- Major:* Human-caused noise is commonly present throughout an area and masks natural sounds for extended periods of time at medium to high noise intensity levels. Noise is audible at a distance and may be of high intensity in close proximity to the source.

## IMPACTS OF THE ALTERNATIVES

### Alternative A: No Action (Continue Existing Non-native Ungulate Management Activities)

#### Analysis

Actions associated with the use of firearms, vehicles, helicopters, and fence maintenance equipment under alternative A would have short-term moderate adverse impacts in all acoustic sampling areas at the park, as noise events from management actions would result in low to medium noise levels over brief intervals or high noise levels over very brief intervals. Most non-native ungulate removal efforts involve monitoring, snaring, trapping, and/or ground shooting; when needed, aerial operations are short, lasting no more than a couple of hours (see description in the “Elements Common to All Action Alternatives” section in chapter 2). Some aerial assistance may also be required during monitoring for non-native ungulates prior to reduction, and would be needed for fence repairs. Use of helicopters for these efforts would be intermittent and would last up to several hours at a time. Currently, ACETA flights last from 1 to 2 hours, during which the helicopter is flying at approximately 300 feet (91 meters) AGL searching for ungulates. When target animals are sighted, the helicopter then descends to between 30 and 60 feet (between 9 and 18 meters) AGL, depending on the surrounding vegetation. Due to the height of helicopter flights, noise levels generated at ground level would be well above the natural ambient sound level; however, such increases would be short term, only lasting for the duration of the management event. Ground shooting efforts may last a full day at a time, but it is assumed that shooting would not occur continuously for all hours during the management activity. Depending on where they are located, the use of firearms (either from the air or ground) would cause temporary increases in noise levels above the natural ambient levels to levels that could be considered high, for very brief periods of time. The use of noise suppressors for ground shooting would be considered, which would reduce impacts on the natural soundscape. However, noise associated with management actions would still temporarily mask natural sounds while management actions are being executed, and some noise (e.g., helicopters) could be audible at a distance, affecting the overall soundscape.

As part of non-native ungulate management, fence maintenance could require the use of a gasoline generator, pneumatic post driver, and rock drill. Noise levels generated by these pieces of equipment would be high in the immediate vicinity of the fence construction and would attenuate to medium levels at greater distances from the source. Generally, fences are located away from visitor campsites and most trails or they are obscured by dense vegetation so that noise is attenuated and intrusions are minimized.

Vehicle usage for non-native ungulate management activities in portions of zones that contain accessible roadways would contribute minimally to impacts on soundscapes. In most areas of the park, the number of vehicle trips associated with management activities, as well the volume of vehicles at any given time, would be insignificant and would not be noticeable relative to the vehicles traveling on these roadways for standard visitor uses, thereby resulting in negligible adverse impacts. In Kahuku, the number of vehicle trips associated with the management activities, as well as the volume of vehicles at any given time, would be few; however, though infrequent, the vehicle trips would be noticeable considering that few vehicles currently enter this area. No long-term effects on the natural quiet would occur from management actions.

The removal and exclusion of non-native ungulates would support the restoration of vegetation, which in turn would help attenuate human-caused sounds. It would also improve wildlife habitat, which could lead to an increase in natural sounds as populations of insects and birds increase.

In summary, alternative A would result in short-term moderate adverse impacts to soundscapes because ground-based and aerial management actions have the potential for brief periods of low to medium noise

levels, with the potential for very brief moments of high noise levels. In the older section of the park, long-term beneficial impacts on soundscapes would result through the continuation of ungulate exclusion in current management units. However, long-term benefits would be unlikely for Kahuku and areas currently unmanaged (e.g., portions of ‘Ōla‘a), for which no established population-level objective and fencing strategy has been identified. Also, the implementation of management tools and monitoring would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities. Because alternative A would not incorporate the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, it would be less likely that the NPS would progress through management phases, monitor, and apply management tools consistently as staff and institutional knowledge change over time.

### **Cumulative Impacts**

Many past, current, and reasonably foreseeable future actions, plans, and programs affect the natural soundscape of the park, which could contribute to beneficial cumulative impacts on natural soundscapes. For example, non-native animal management inside the park and restoration of vegetation and sensitive species (including those addressed as part of USFWS recovery plans) may positively affect sound propagation to reduce intrusive human-induced sounds in portions of the park. The fire management plan would also contribute to the protection of vegetation, which could positively affect sound attenuation. Furthermore, the implementation of the ATMP in the future will provide acceptable and effective measures to mitigate or prevent significant adverse impacts, if any, from commercial air tour operations on the natural soundscape. Future implementation of the GMP will also provide beneficial effects on the natural soundscape, given that the GMP will address resource protection for the entire park.

Aside from actions resulting in beneficial effects, there are several past, current, and future actions, plans, and programs that could contribute to adverse cumulative effects on the natural soundscape. For example, some of the actions noted above may have short-term impacts from noise associated with the presence of people and equipment during implementation. Additionally, development and maintenance of park facilities, including roads and boundary fences, may result in temporarily increased noise levels and sounds inconsistent with park purposes or uses, thereby adversely affecting the natural soundscape. Additionally, air tour flights can occur with frequency in one area of the park, concentrating air tours on paths or in certain areas due to the volcanic activity visible. Changes in volcanic activity often result in increased visitation and subsequent increases in air tour numbers, which in turn may cause increased intrusions of human-created sounds on the natural soundscape of the park. Hawai‘i Volcanoes National Park has been known to experience 30 to 60 air tour flights per day when lava is visible. Although the creation of the ATMP might help to limit the numbers and impacts of air tours, the noise from air tours is anticipated to continue to add to the cumulative impacts on the soundscape. Impacts are anticipated to be greater prior to ATMP implementation. Changes in visitation at the park would likely also contribute to localized disturbances of natural soundscapes due to fluctuations in visitors in particular locations. Law enforcement activities would contribute to localized minor adverse impacts should law enforcement officials need to conduct activities that could disturb the natural soundscape, such as operating vehicles.

Activities on adjoining lands outside park boundaries could also impact park soundscapes. Land-clearing activities, such as those associated with logging, agriculture, and urbanization, not only contribute short-term impacts on soundscapes from the presence of people and equipment, but also long-term impacts from the loss of vegetation. This may affect sound propagation such that unwanted noise sources may travel more freely through open areas with less vegetation cover, thereby lengthening the extent of impacts from a particular sound source.

These past, present, and reasonably foreseeable future actions would have short-term moderate adverse and long-term beneficial impacts on soundscapes. Past, present, and reasonably foreseeable future actions,

when combined with the short-term moderate adverse impacts of alternative A, would result in short-term moderate adverse cumulative impacts on soundscapes. Long-term beneficial cumulative impacts would be less likely under alternative A, because non-native ungulate management within the park would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

## **Conclusion**

Under alternative A, short-term moderate adverse impacts to soundscapes would result from ground-based and aerial management actions. In the older section of the park, long-term beneficial impacts on soundscapes would result through the continuation of ungulate exclusion in current management units. Long-term beneficial impacts would be unlikely for the Kahuku unit and areas currently unmanaged (e.g., portions of ‘Ōla‘a), where no established population-level objective or fencing strategy has been identified in a comprehensive and systematic plan. The effects of alternative A, when combined with impacts of past, present, and reasonably foreseeable actions on soundscapes, would have short-term moderate adverse cumulative impacts. Long-term beneficial cumulative impacts would be less likely under alternative A, because non-native ungulate management would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

## **Alternative B: Comprehensive Management Plan that Uses Lethal Removal Techniques**

### **Analysis**

Alternative B would result in short-term moderate adverse impacts caused by the use of firearms, vehicles, helicopters, and fence maintenance equipment, which would create low to medium noise levels over brief intervals or high noise levels over very brief intervals. Most non-native ungulate removal efforts involve monitoring, snaring, trapping, and/or ground shooting; when needed, aerial operations are short, lasting no more than a couple of hours (see description in the “Elements Common to All Action Alternatives” section in chapter 2). Some aerial assistance may also be required during monitoring for non-native ungulates prior to reduction, and would be needed for fence repairs. Use of helicopters for these efforts would be intermittent and would last up to several hours at a time. Currently, ACETA flights last from 1 to 2 hours, during which the helicopter is flying at approximately 300 feet (91 meters) AGL searching for ungulates. When target animals are sighted, the helicopter then descends to between 30 and 60 feet (between 9 and 18 meters) AGL, depending on the surrounding vegetation. Due to the height of helicopter flights, noise levels generated at ground level would be well above the natural ambient sound level; however, such increases would be short term, only lasting for the duration of the management event. Ground shooting efforts may last a full day at a time, but it is assumed that shooting would not occur continuously for all hours during the management activity. Depending on where they are located, the use of firearms (either from the air or ground) would cause temporary increases in noise levels above the natural ambient levels to levels that could be considered high, for very brief periods of time. The use of noise suppressors for ground shooting would be considered, which would reduce impacts on the natural soundscape. However, noise associated with management actions would still temporarily mask natural sounds while management actions are being executed, and some noise (e.g., helicopters) could be audible at a distance, affecting the overall soundscape.

As part of non-native ungulate management, fence maintenance could require the use of a gasoline generator, pneumatic post driver, and rock drill. Noise levels generated by these pieces of equipment would be high in the immediate vicinity of the fence construction and would attenuate to medium levels

at greater distances from the source. Generally, fences are located away from visitor campsites and most trails or they are obscured by dense vegetation so that noise is attenuated and intrusions are minimized.

Vehicle usage for non-native ungulate management activities in portions of zones that contain accessible roadways would contribute minimally to impacts on soundscapes. In most areas of the park, the number of vehicle trips associated with management activities, as well the volume of vehicles at any given time, would be insignificant and would not be noticeable relative to the vehicles traveling on these roadways for standard visitor uses, thereby resulting in negligible adverse impacts. In Kahuku, the number of vehicle trips associated with the management activities, as well as the volume of vehicles at any given time, would be few; however, though infrequent, the vehicle trips would be noticeable considering that few vehicles currently enter this area. No long-term effects on the natural quiet would occur from management actions.

The removal and exclusion of non-native ungulates would support the restoration of vegetation, which in turn would help attenuate human-caused sounds. It would also improve wildlife habitat, which could lead to an increase in natural sounds as populations of insects and birds increase.

Long-term beneficial and short-term moderate adverse impacts on soundscapes would result from implementation of alternative B. Long-term benefits would be fully realized because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative B would be the same as alternative A. The short-term moderate adverse and long-term beneficial impacts of past, present, and reasonably foreseeable future actions on soundscapes, when combined with the impacts of implementing alternative B, would have short-term moderate adverse and long-term beneficial cumulative impacts. Long-term benefits would be fully realized because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Conclusion**

Under alternative B, short-term moderate adverse impacts to soundscapes would result from the use of firearms, vehicles, helicopters, and fence maintenance equipment. Long-term beneficial impacts to soundscapes would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

The effects of alternative B, when combined with impacts of past, present, and reasonably foreseeable actions on soundscapes, would have short-term moderate adverse and long-term beneficial cumulative impacts.

## **Alternative C: Comprehensive Management Plan that Maximizes Efficiency by Expanding Lethal Removal Techniques and Discontinuing the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative C would result in short-term moderate adverse impacts to soundscapes in all acoustic sampling areas in the park. Long-term beneficial impacts to soundscapes would be fully realized under alternative C.

Because lethal techniques would be expanded and enhanced, and volunteers would not be used during direct reduction efforts under alternative C, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative B. The increased efficiency associated with discontinuing the use of volunteers is based on additional work required by NPS staff to recruit, administer, train and direct volunteers in the field, and data that show that park staff remove more ungulates per day when they conduct direct reduction (ground shooting) themselves, compared to when they are accompanied by volunteers (Stephens et al. 2008). Therefore, fewer reduction activities would result when compared to alternative B.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative C would be the same as alternative A. Similar to alternative B, the long-term beneficial and short-term moderate adverse impacts of past, present, and reasonably foreseeable future actions on soundscapes, when combined with the impacts of implementing alternative C, would have long-term beneficial and short-term moderate adverse cumulative impacts.

### **Conclusion**

Under alternative C, short-term moderate adverse impacts to soundscapes would result from the use of firearms, vehicles, helicopters, and fence maintenance equipment. Long-term beneficial impacts to soundscapes would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative C than under alternative B. The effects of alternative C, when combined with impacts of past, present, and reasonably foreseeable actions on soundscapes, would have short-term moderate adverse and long-term beneficial cumulative impacts.

## **Alternative D: Comprehensive Management Plan that Maximizes Flexibility of Management Techniques**

### **Analysis**

Similar to alternative B, alternative D would result in short-term moderate adverse impacts to soundscapes in all acoustic sampling areas in the park. Long-term beneficial impacts to soundscapes would be fully realized under alternative D.

Under alternative D, it is possible that increased human and vehicular traffic associated with potential relocation activities could cause additional disturbance to soundscapes during the process of driving animals to adjacent lands. However, these impacts would be short-term and localized, and similar to impacts of other management actions.

Although the expansion and enhancement of lethal removal techniques under alternative D would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the continued use of volunteers and the expansion of non-lethal techniques would counteract this to some extent. Inclusion of non-lethal removal would require additional staff time and park resources to relocate animals to adjacent lands, and may increase the time associated with reduction actions over the life of the plan, as well as time needed to reach the post-reduction phase. As a result, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative D would be the same as alternative A. Similar to alternative B, the long-term beneficial and short-term moderate adverse impacts of past, present, and reasonably foreseeable future actions on soundscapes, when combined with the impacts of implementing alternative D, would have long-term beneficial and short- and long-term minor to moderate adverse cumulative impacts.

### **Conclusion**

Under alternative D, short-term moderate adverse impacts to soundscapes would result from the use of firearms, vehicles, helicopters, and fence maintenance equipment. Long-term beneficial impacts to soundscapes would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly under alternative D than under alternative C. The effects of alternative D, when combined with impacts of past, present, and reasonably foreseeable actions on soundscapes, would have short-term moderate adverse and long-term beneficial cumulative impacts.

## **Alternative E: Comprehensive Management Plan that Increases Flexibility of Management Techniques While Limiting the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative E would result in short-term moderate adverse impacts to soundscapes in all acoustic sampling areas in the park. Long-term beneficial impacts to soundscapes would be fully realized under alternative E.

Similar to alternative D, it is possible that potential relocation activities could cause additional disturbance to soundscapes during the process of driving animals to adjacent lands under alternative E.

Although the expansion and enhancement of lethal removal techniques under alternative E would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the expansion of non-lethal techniques would counteract this to some extent. However, because volunteers would not be used during direct reduction efforts under alternative E, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative D, but less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative E would be the same as alternative A. Similar to alternative B, the long-term beneficial and short-term moderate adverse impacts of past, present, and reasonably foreseeable future actions on soundscapes, when combined with the

impacts of implementing alternative E, would have long-term beneficial and short-term moderate adverse cumulative impacts.

### **Conclusion**

Under alternative E, short-term moderate adverse impacts to soundscapes would result from the use of firearms, vehicles, helicopters, and fence maintenance equipment. Long-term beneficial impacts to soundscapes would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative E than under alternative D, but less quickly than under alternative C. The effects of alternative E, when combined with impacts of past, present, and reasonably foreseeable actions on soundscapes, would have short-term moderate adverse and long-term beneficial cumulative impacts.

## **LAND MANAGEMENT ADJACENT TO THE PARK**

### **GUIDING REGULATIONS AND POLICIES**

The CEQ regulations implementing NEPA (40 CFR 1502.16 and 1506.2[d]) and Director's Order 12 (NPS 2011) require that the NPS consider the possible conflicts between an action and the objectives of other federal, state, local, or tribal land use plans, policies, and controls for an area.

### **METHODOLOGY, ASSUMPTIONS, AND IMPACT THRESHOLDS**

The assessment of potential impacts on land management adjacent to the park focuses on the effects of non-native ungulate management activities in the park on the goals and objectives for the numerous federal, state, and nonprofit entities surrounding the park, as well as other conservation efforts and development outside the park. Management of non-native ungulates is assumed to be compatible with the goals and objectives of the land use plans/of those agencies that also engage in non-native ungulate management, such as the Natural Area Reserves System, Kamehameha Schools, and TNC, and would not affect the land management of these entities adversely. The social and economic effects on adjacent private lands are considered under the "Socioeconomics" impact topic discussed in this chapter. According to NPS-NEPA practice, impact intensity thresholds are defined for adverse impacts based on the potential for changes to such characteristics, as follows:

- Negligible:* Goals and objectives for adjacent land management would not be impacted, and there would be minimal changes in how these areas are administered. These changes would not be of any measurable or perceptible consequence.
- Minor:* Impacts would not preclude an agency's ability to meet goals and objectives for surrounding lands, although there could be some effects that are not compatible. Changes in how areas are administered could occur, but they would be simple and would not appreciably affect the agency responsible for managing the land.
- Moderate:* Impacts would not be compatible with an agency's goals and objectives for surrounding lands, although impacts would not preclude their ability to meet the related desired conditions. Changes in how areas are administered would be required, but they would be simple and would not appreciably affect the agency responsible for managing the land.

*Major:* Impacts would not be compatible with an agency's goals and objectives for surrounding lands and would preclude their ability to meet the related desired conditions. Changes in how areas are administered would be required and would appreciably affect the agency responsible for managing the land.

## **IMPACTS OF THE ALTERNATIVES**

### **Alternative A: No Action (Continue Existing Non-native Ungulate Management Activities)**

#### **Analysis**

Under alternative A, park staff would continue to monitor and remove ingress ungulates from existing managed units. Where existing boundary fences occur, impacts of removal efforts on non-native ungulate populations outside the park would be minimal.

For adjacent landowners seeking to protect native species and ecosystems on portions of their lands (e.g., state, federal and private non-profit members of TMA) they could experience benefits from the repair, installation, and maintenance of park boundary fences, which would also serve as boundary fences on their lands. Also, recovery of native species and habitat as a result of ungulate management inside the park would benefit adjacent members sharing similar goals, through facilitating species movement into the area and restoring habitat connectivity. The NPS would continue to coordinate with these entities by sharing information, allowing access to NPS lands for research, and providing assistance at similar to current levels.

Impacts of any future removal efforts would be uncertain for areas adjacent to currently unmanaged portions of the park and for which no population objective or fencing strategy has been identified (e.g., portions of 'Ōla'a and Kahuku). Without a comprehensive plan articulating these goals and management implementation, non-native ungulate removal could potentially impact populations outside the park. Local concentrations of these animals could remain the same, increase, or decrease, depending on the actions taken by park staff and the location of future fences. Adjacent lands with the potential to be impacted include state lands with goals for game management, as well as areas managed by federal and state agencies, and nonprofit organizations who seek to protect native species and ecosystems through ungulate removal and fencing. However, for these and other landowners adjacent to the park, actions on NPS lands to manage non-native ungulates would not change how their lands are administered and would not preclude adjacent land managers from ultimately achieving their desired conditions.

In summary, alternative A would result in short- and long-term negligible to moderate adverse and beneficial impacts on land management adjacent to current park management units. Where existing boundary fences occur, impacts of removal efforts on non-native ungulate populations outside the park would be negligible. However, impacts of any future removal efforts would be uncertain for areas adjacent to currently unmanaged portions of the park (e.g., portions of 'Ōla'a and Kahuku).

#### **Cumulative Impacts**

Other past, present and reasonably foreseeable future actions on adjacent lands, including the introduction of non-native ungulate game species to the island, can influence the population of non-native ungulates in the park and in adjacent lands. Other activities, such as land clearing, grazing, ranching, and development outside the park (partly as a result of community planning in the area) have decreased available habitat in the area. Although no additional game animals have been brought to the island, the state currently maintains these populations in adjacent lands for hunting, an activity which is expected to continue for the

life of this plan. Other past actions that still occur and would be expected to continue to occur include grazing; ranching; development leading to urbanization, which includes a shift in demographics and an increase in the demand for second homes on the island; and changes in the fire regime on the island.

As the number of non-native species increases, habitat alteration occurs and the native species in the area decline. Related impacts on natural and cultural resources create long-term minor to moderate adverse impacts for some land managers with a focus on preserving natural and cultural resources, as these impacts are not compatible with their management objectives. For those land managers that depend on non-native ungulates as a game species, their continued presence could result in long-term beneficial impacts.

Other actions occurring on the island both in the past and into the future include non-native ungulate management and fencing efforts outside the park on state and federal lands to remove and exclude ungulates, implementation of USFWS recovery plans for sensitive species inside and outside the park, control of other non-native species both inside the park and on adjacent lands, and other conservation efforts inside and outside the park. These activities would benefit agencies and other entities adjacent to the park whose land management goals included perpetuation of native species and ecosystems. These actions would all have long-term beneficial impacts on land management at the park, as well as on surrounding lands.

Land management on adjacent lands is also influenced by past, present, and future park planning efforts, such as land acquisition (the past acquisition of Kahuku and any potential future acquisitions), development and implementation of the GMP, fire management plans, the proposed Mauna Loa trail system (an ongoing feasibility study), the implementation of the *Ala Kahakai National Historic Trail Management Plan*, and air tour planning (including current activities and the future implementation of the ATMP). Many of these plans would have beneficial impacts on land management on NPS lands, as well as adjacent lands. Fire management at the urban/wildland interface would benefit land management on adjacent lands, as large-scale fire events would be prevented. Further beneficial impacts could result from the NPS acquisition of any future lands by preserving these lands and managing them in accordance with NPS policies. These policies, which direct management of non-native species, vegetation, wilderness, and fire, would have beneficial impacts on any lands managed by the NPS.

These past, present, and reasonably foreseeable future actions would have long-term minor to moderate adverse and beneficial impacts to land management agencies adjacent to the park. Past, present, and reasonably foreseeable future actions, when combined with the impacts of alternative A, would have long-term minor to moderate adverse and beneficial cumulative impacts on land management adjacent to the park.

## **Conclusion**

Alternative A would result in short- and long-term negligible to moderate adverse and beneficial impacts on land management adjacent to current park management units. Where existing boundary fences occur, impacts of removal efforts on non-native ungulate populations outside the park would be negligible. However, impacts of any future removal efforts would be uncertain in areas currently unmanaged and for which no population objective or fencing strategy has been identified (e.g., portions of 'Ōla'a and Kahuku). The long-term minor to moderate adverse and beneficial impacts of past, present, and reasonably foreseeable future actions on land management adjacent to the park, when combined with the impacts of implementing alternative A, would have long-term minor to moderate adverse and beneficial cumulative impacts on land management adjacent to the park.

## **Alternative B: Comprehensive Management Plan that Uses Lethal Removal Techniques**

### **Analysis**

Under alternative B, park boundary fences would limit the impact of removal efforts inside the park on non-native ungulate populations outside the park. Where boundary fences already exist, impacts of removal efforts on non-native ungulate populations outside the park would be minimal.

In areas where new boundary fences are proposed, fences would have minimal impacts on population movements for deer, mouflon hybrids, feral cattle and goats, and other animals which have no established populations but may occur as occasional individuals in the park. Movement of pigs and mouflon are limited to local areas (Giffin 1982, Diong 1982). Pigs are feral animals that easily adapt to their environment with populations able to thrive in a wide range of habitats. Studies in tropical forest in Hawai'i and Australia indicate that feral pigs are sedentary staying largely within their home ranges (Giffin 1978, Mitchell et al. 2009, Salbosa and Lepczyk 2009). In Kahuku where there are established mouflon populations in the park, a two year telemetry study by Hess (Loh, pers. comm., 2012) indicated that animals have relatively small home ranges with individuals collared in the park staying primarily in the park and rarely venturing into the adjacent state forest reserve below. There are no mouflon populations established in other areas of the park.

Several hundred feral sheep located in the northwest corner of kahuku (above 7,000 ft elevation) move back and forth between the adjacent private ranch and the park. The vegetation inside this area of the park is sparse with little available forage for sheep. Park fences would prevent sheep from entering the park where they could be lethally removed.

Proposed new boundary fences, would minimize impacts of removal efforts conducted inside the park on populations outside the park. Local concentrations of these animals could remain the same, increase, or decrease, depending on available forage, appropriate habitat, and carrying capacity on adjacent lands.

Adjacent lands with the potential to be impacted include areas managed by federal and state agencies, as well as nonprofit organizations that practice non-native ungulate management on portions of their lands through removal and fencing. Entities in this group include the NPS, USFWS, State of Hawai'i, Kamehameha Schools, and TNC. Under alternative B, the NPS would continue to coordinate with these entities by sharing information, allowing access to NPS lands for research, and providing assistance at similar to current levels. Actions on NPS lands to manage non-native ungulates would not change how these lands are administered and would not preclude adjacent land managers from ultimately achieving their desired conditions. As co-members of the TMA share property boundaries with the NPS, they could experience benefits from the repair, installation, and maintenance of park boundary fences, which would also serve as boundary fences on their lands. Also, recovery of native species and habitat as a result of ungulate management inside the park would benefit recovery efforts by adjacent members, via facilitating native species movement into the area and restoring habitat connectivity.

In addition to these interests, state lands with goals for game management also exist adjacent to the park. Management in the adjacent State Forest Reserves and Game Management Areas include regulations to maintain game animal populations, such as bag limits, combined with objectives related to recreation and forestry. For these and other state or privately owned lands, actions on NPS lands to manage non-native ungulates would not change how these lands are administered and would not preclude adjacent land managers from ultimately achieving their desired conditions. Consequently, a potential change in non-native ungulate populations outside the park would have short- and long-term negligible to minor adverse and beneficial impacts on these areas, depending on how they would continue to be managed for multiple uses.

In summary, alternative B would result in short- and long-term negligible to minor adverse and beneficial impacts on land management adjacent to current park management units.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative B would be the same as alternative A. The long-term minor to moderate adverse and beneficial impacts of past, present, and reasonably foreseeable future actions on land management adjacent to the park, when combined with the impacts of implementing alternative B, would have long-term, minor to moderate adverse and beneficial cumulative impacts on land management adjacent to the park.

### **Conclusion**

Alternative B would result in short- and long-term negligible to minor adverse and beneficial impacts on land management adjacent to the park. Proposed new boundary fences, would minimize impacts of removal efforts conducted inside the park on populations outside the park. The long-term minor to moderate adverse and beneficial impacts of past, present, and reasonably foreseeable future actions on land management adjacent to the park, when combined with the impacts of implementing alternative B, would have long-term, minor to moderate adverse and beneficial cumulative impacts on land management adjacent to the park.

## **Alternative C: Comprehensive Management Plan that Maximizes Efficiency by Expanding Lethal Removal Techniques and Discontinuing the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative C would result in short- and long-term negligible to minor adverse and beneficial impacts on land management adjacent to current park management units. Boundary fences would minimize impacts of removal efforts on non-native ungulate populations outside the park.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative C would be the same as alternative A. Similar to alternative B, the long-term minor to moderate adverse and beneficial impacts of past, present, and reasonably foreseeable future actions on land management adjacent to the park, when combined with the impacts of implementing alternative C, would have long-term, minor to moderate adverse and beneficial cumulative impacts on land management adjacent to the park.

### **Conclusion**

Alternative C would result in short- and long-term negligible to minor adverse and beneficial impacts on land management adjacent to current park management units. Boundary fences would minimize impacts of removal efforts on non-native ungulate populations located outside the park. The long-term minor to moderate adverse and beneficial impacts of past, present, and reasonably foreseeable future actions on land management adjacent to the park, when combined with the impacts of implementing alternative C, would have long-term, minor to moderate adverse and beneficial cumulative impacts on land management adjacent to the park.

### **Alternative D: Comprehensive Management Plan that Maximizes Flexibility of Management Techniques**

#### **Analysis**

Similar to alternative B, alternative D would result in short- and long-term negligible to minor adverse and beneficial impacts on land management adjacent to current park management units. Boundary fences would minimize impacts of removal efforts on non-native ungulate populations outside the park.

Under alternative D, the NPS would investigate the possibility of relocating non-native ungulates, such as feral sheep, mouflon and pigs, to adjacent lands. In order to minimize potential adverse impacts of moving animals, all potential relocation activities would require willing recipients and would be carried out in close cooperation with the state. Animals would only be relocated to adjacent lands where populations are already established in large numbers and sites where undesirable impacts to the environment would be avoided. Relocation could provide some benefits to the willing recipient depending on their land management objectives (e.g., increasing game opportunities).

#### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative D would be the same as alternative A. Similar to alternative B, the long-term minor to moderate adverse and beneficial impacts of past, present, and reasonably foreseeable future actions on land management adjacent to the park, when combined with the impacts of implementing alternative D, would have long-term, minor to moderate adverse and beneficial cumulative impacts on land management adjacent to the park.

#### **Conclusion**

Alternative D would result in short- and long-term negligible to minor adverse and beneficial impacts on land management adjacent to current park management units. Boundary fences would minimize impacts of removal efforts on non-native ungulate populations located outside the park. Animals would only be relocated to adjacent lands where populations are already established in large numbers and avoid sites where undesirable impacts to the environment would occur. The long-term minor to moderate adverse and beneficial impacts of past, present, and reasonably foreseeable future actions on land management adjacent to the park, when combined with the impacts of implementing alternative D, would have long-term, minor to moderate adverse and beneficial cumulative impacts on land management adjacent to the park.

### **Alternative E: Comprehensive Management Plan that Increases Flexibility of Management Techniques While Limiting the Use of Volunteers**

#### **Analysis**

Similar to alternative B, alternative E would result in short- and long-term negligible to minor adverse and beneficial impacts on land management adjacent to current park management units. Boundary fences would minimize impacts of removal efforts on non-native ungulate populations outside the park.

Similar to alternative D, potential relocation activities would require willing recipients and would be carried out in close cooperation with the state. Animals would only be relocated to adjacent areas where population are already established in large numbers and avoid sites where undesirable impacts to the environment would occur. Any necessary permissions and permits would be obtained prior to relocation activities. Prior to transporting animals to other locations, any necessary disease testing required by the

state would be conducted. Relocation could provide some benefits to the willing recipient depending on their land management objectives (e.g., increasing game opportunities).

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative E would be the same as alternative A. Similar to alternative B, the long-term minor to moderate adverse and beneficial impacts of past, present, and reasonably foreseeable future actions on land management adjacent to the park, when combined with the impacts of implementing alternative E, would have long-term, minor to moderate adverse and beneficial cumulative impacts on land management adjacent to the park.

### **Conclusion**

Alternative E would result in short- and long-term negligible to minor adverse and beneficial impacts on land management adjacent to current park management units. Boundary fences would minimize impacts of removal efforts on non-native ungulate populations located outside the park. Animals would only be relocated to adjacent areas where populations are already established in large numbers and avoid sites where undesirable impacts to the environment would occur. The long-term minor to moderate adverse and beneficial impacts of past, present, and reasonably foreseeable future actions on land management adjacent to the park, when combined with the impacts of implementing alternative E, would have long-term, minor to moderate adverse and beneficial cumulative impacts on land management adjacent to the park.

## **SOCIOECONOMICS**

### **GUIDING REGULATIONS AND POLICIES**

NEPA requires an EIS for any major federal action that significantly affects the human environment, including the socioeconomic effects of a proposal. In addition, NEPA requires that agencies examine the indirect effects of their proposed actions, which are defined as “reasonably foreseeable impacts that occur removed in time or space from the proposed action” (40 CFR 1508.8). For instance, such indirect effects of an agency’s proposal could include impacts on land uses and resources of neighboring local, state, or federal land jurisdictions. In addition, the NPS *Management Policies 2006* charges the NPS with working “cooperatively with others to improve the condition of parks ... and to integrate parks into sustainable ecological, cultural, and socioeconomic systems” (NPS 2006b, Section 2.1.3). The same policies discuss impacts as “the likely effect of an action or proposed action upon specific natural, cultural, or socioeconomic resources” (NPS 2006b, Glossary).

### **METHODOLOGY, ASSUMPTIONS, AND IMPACT THRESHOLDS**

The study area analyzed for the socioeconomic impacts of the proposed alternatives is Hawai‘i County, which encompasses Hawai‘i Volcanoes National Park and includes the entire Big Island of Hawai‘i.

This section analyzes the relationships among the non-native ungulate management options and socioeconomic variables in the region. The relevant socioeconomic variables identified in this analysis include the number of recreational visits, the economic impacts of park recreation and tourism on spending, park spending and payroll impacts, income and jobs in the local economy, and the social values of local communities, visitors, and adjacent private landowners. The socioeconomic impacts from each alternative are evaluated for visitation and recreation; nonmarket social values, and NPS spending and payroll. The specific impacts are discussed in more detail below.

The NPS uses the Money Generation Model to estimate the economic impacts of park unit recreation visits and park payroll on local economies. The economic impacts of Hawai'i Volcanoes National Park were evaluated using the Money Generation Model for the year 2007 (Stynes 2008). Current policies and prevailing conditions provide the basis for constructing baseline conditions in the no-action alternative. Each action alternative is assessed relative to the no-action alternative.

Impact intensity thresholds were defined for adverse impacts. For this plan/EIS, assignment of intensity levels for socioeconomic impacts are based on the potential for changes to such characteristics as follows:

- Negligible:* 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 alternative would affect only a few adjacent landowners.
- Moderate:* The effects on neighboring landowners or other socioeconomic conditions would be readily apparent. Changes would be confined locally, and would affect more than a few adjacent landowners.
- Major:* The effects on neighboring landowners or other socioeconomic conditions would be readily apparent and substantial. Changes would extend beyond the local area, and would affect the majority of adjacent landowners.

## **IMPACTS OF THE ALTERNATIVES**

### **Alternative A: No Action (Continue Existing Non-native Ungulate Management Activities)**

#### **Analysis**

##### ***Visitation and Recreation***

Hawai'i Volcanoes National Park attracts millions of visitors a year; between 1990 and 2009, the park experienced an average of approximately 1.3 million visitors annually. These visitors spend their money on hotels, restaurants, and retail, supporting local business in the region. In 2007, total spending from nonlocal visitors was estimated to be \$109 million, generating \$67 million in gross regional product, \$43 million in labor income, and supporting 2,199 jobs on the island (Stynes 2008).

Under the no-action alternative, implementation of management actions, including monitoring, direct reduction with firearms, and fencing, would temporarily create noise from the use of helicopters and/or firearms that could have social effects on visitors, local communities, or adjacent private landowners. However, the use of helicopters is limited typically to one to two hours and are confined to specific areas of the park. Fences are generally located away from visitor campsites and most trails or are obscured by dense vegetation, which reduces the potential for visual and aesthetic impacts.

Temporary closures could be used to minimize visitor exposure to management actions, but they also could preclude visitors from accessing an area to engage in desired recreational opportunities. Considering past experience, closures would generally be used infrequently, and the public would be notified of them in advance so they can adjust their plans. Actions may begin in the early morning and continue throughout the day; however, in areas where visitor use is high, actions would typically be

limited to the early morning or off-peak hours in order to reduce impacts on visitor use, reducing the frequency and duration of closures. In addition, the entire park would not be closed to the public for management actions. A diversity of key visitor destinations would always be open and available for visitation to accommodate park visitors during any localized temporary closures.

Because temporary impacts from management actions would not appreciably affect visitor satisfaction at the park or cause changes in the number of visitors, alternative A would not affect the contribution that tourism and recreational spending has to local economies.

### *Nonmarket Social Values*

Local economies are not expected to be affected, as there are no changes in visitation expected; however, there are non-market social and environmental values that would be affected by the recreational experience and condition of the resource. For example, visitors and residents who value a quiet, natural experience could be adversely affected in the short term due to temporary closures, noise, and the presence of fencing. Conversely, visitors would experience beneficial impacts as a result of increased opportunities for viewing native species and ecosystems (please refer to the “Visitor Use and Experience” section of this chapter).

Although lethal methods of non-native ungulate control are notably efficient and cost-effective approaches to meet the objective of zero ungulates in park lands, these lethal methods could be more controversial and less socially acceptable than other, non-lethal, methods. As a result, alternative A is expected to have short-term minor adverse impacts on the experiences and perceptions of some residents, visitors, and stakeholders. Over time, these adverse effects will decrease as fewer ungulates will need to be removed by lethal methods.

Conversely, the volunteer control program provides social benefits to local residents, and the program attracts high volunteer interest (NPS 2007c). The majority of volunteers are typically from local communities on the Island of Hawai‘i. This program allows local residents to participate in the protection of resources in the park; provides interaction with the park staff, which supports social connectedness and public–federal relations; and promotes communication among landowners of the region. As the participants typically participate only once in the volunteer program, and because the park is surrounded by public hunting areas in state game and forest reserves that are routinely used by the communities in the areas of concern, the benefits derived from the NPS volunteer control program are relatively minor. Therefore, it is expected that the social effects of alternative A would continue to have short-term beneficial impacts on community residents who participate in this program.

The non-native ungulate management actions under alternative A would reduce threats posed by animals to native ecosystems, and support protection of rare, unique, threatened, or endangered species and their habitat in the park that contribute to the park’s designation as a biosphere reserve and world heritage site, which attracts visitors from around the world. In the older section of the park, such long-term beneficial impacts would result through the continuation of ungulate exclusion in current management units. However, long-term benefits would be unlikely for Kahuku and areas currently unmanaged (e.g., portions of ‘Ōla‘a), for which no established population-level objective and fencing strategy has been identified. Also, the implementation of management tools and monitoring would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities. Because alternative A would not incorporate the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, it would be less likely that the NPS would progress through management phases, monitor, and apply management tools consistently as staff and institutional knowledge change over time.

### ***NPS Spending and Payroll***

Hawai'i Volcanoes National Park also contributes to the local economy by providing jobs to park employees, including seasonal, term, and permanent full-time or part-time positions (see the "Park Management and Operations" section of chapter 3 for more detail). The park also supports the local economy when local vendors are used for purchases, supplies, and/or contracted services, such as fencing supplies.

Under alternative A, the socioeconomic impacts of the non-native ungulate management program would have beneficial impacts on local communities as a result of park payroll and spending on non-native ungulate control, fencing, and related supplies. Funding for non-native ungulate monitoring and removal, fence repair and replacement equaled a total of \$921,000 per year, averaged across the 3 years from FY 2006 to FY 2008 (Loh, pers. comm., 2010a), and included management activities in the Kahuku unit (i.e., new fence construction, monitoring and ungulate removal, and administration of the Volunteer Ungulate Control Program). This was approximately 14 percent of the park budget in FY 2008.

### **Cumulative Impacts**

Other past, present, and reasonably foreseeable future actions in and around the park have affected or could affect the socioeconomic resources in the region. Although there have been historic actions that have caused adverse impacts on the natural environmental conditions, there are cumulative management actions that have the possibility to reverse and improve these resource conditions, beneficially impacting socioeconomic variables in the long term.

Land clearing, habitat fragmentation, and loss of vegetation, all resulting from past logging activities, agricultural use (including ranching), and development (including residential growth from retirees, demand for second homes, and community land use plans), contribute negatively to those visitors, residents (including landowners adjacent to the park), and second homeowners seeking more pristine conditions. Non-native species introductions and resulting changes in the fire regime also contribute to degradation of natural resources, which affects social values for some residents and visitors. However, past logging activities, agricultural use (including ranching), and development (including growth from retirees, demand for second homes, and community land use plans) have also contributed to an increase in money coming into and being spent in the community. Increased aviation activities inside and outside the park can create excessive noise from overflights, negatively impacting visitors and residents who value natural quiet, while at the same time contributing to the positive economic growth on the island (e.g., commercial air tours).

Some of these negative effects would be offset by other past, present, and reasonably foreseeable future actions. In addition to these negative effects, many past, current, and future actions, plans, and programs at the park would enhance the experience of visitors, residents, and second homeowners. For example, aviation activities would be managed in accordance with the forthcoming ATMP, which would minimize impacts on park resources. Non-native species management actions that would benefit visitors, residents, and second homeowners by protecting and restoring native habitat on these lands include fencing efforts outside the park on state and federal lands to remove and exclude non-native ungulates; control of other non-native species, both inside the park and on adjacent lands; implementation of USFWS recovery plans for sensitive species in the park; and conservation efforts outside the park. These native ecosystems are what many visitors come to Hawai'i to experience, thus increasing tourism (and tourism spending) when these conditions are met. Fire management activities in the park and on surrounding lands also contribute to these benefits. Fire management at the wildland/urban interface by both the NPS and local communities would also benefit adjacent private landowners, as large-scale fire events would be contained or mitigated through implementation of the park's fire management plans, community wildfire

protection plans, and agreements among federal, state, and county agencies to provide mutual assistance in the event of wildfire. These changes improve the social and environmental values of residents and visitors. If improvements are such that visitation is expected to increase, positive economic impacts on local economies could occur.

Further beneficial impacts would result from the NPS acquisition of Kahuku, as well as the future acquisition of any new lands, by preserving these lands and managing them in accordance with NPS policies. The acquisition of new lands (including Kahuku) would provide for increased areas for visitors and residents to use and experience, and could also alleviate crowding in other sections of the park. Park educational programs and interpretation activities increase awareness of the ecosystems in the park, as well as the cultural importance of the park. The forthcoming GMP will address issues such as (but not limited to) enhancing the visitor experience (e.g., interpretation and educational objectives as well as visitor facilities), cultural and natural resources management, transportation (e.g., roads and trails), commercial services, park spending, and employment. All of these actions would have beneficial impacts on socioeconomics, as they would influence visitation to the park, thus increasing money being spent at the park and in surrounding communities. If NPS employment increases as a result of these activities, this would also have beneficial impacts on local communities.

The state currently maintains populations of feral pigs, goats, mouflon, and sheep on adjacent state lands for hunting, an activity that is expected to continue for the life of this plan. Hunters obtain recreational and social values from these lands and are also allowed to retain the meat from these activities.

These past, present, and reasonably foreseeable future actions would have long-term minor adverse and long-term beneficial impacts on socioeconomic variables, such as visitor spending, economic contribution to local economies, and social and environmental values. Past, present, and reasonably foreseeable future actions, when combined with the short-term negligible to minor adverse impacts, and long-term beneficial impacts of alternative A, would have short- and long-term minor adverse and long-term beneficial cumulative impacts on socioeconomic resources.

## **Conclusion**

Under alternative A, non-native ungulate management program would have beneficial impacts on local communities as a result of park payroll and spending on non-native ungulate control, fencing, and related supplies. Impacts to non-market social values would be minor, short-term, and adverse during control activities. There would be no measurable effect on park visitation and recreation spending. Long-term beneficial impacts to non-market social values through the restoration of native species and communities would be less likely for the Kahuku unit and areas currently unmanaged (e.g., portions of 'Ōla'a), where no established population-level objective, or fencing strategy, or management implementation has been identified in a comprehensive and systematic plan.

The effects of alternative A, when combined with the impacts of past, present, and reasonably foreseeable future actions on socioeconomic resources, would have short- and long-term minor adverse impacts and long-term beneficial impacts on socioeconomic resources. Long-term beneficial cumulative impacts would be less likely under alternative A, because implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

## **Alternative B: Comprehensive Management Plan that Uses Lethal Removal Techniques**

### **Analysis**

#### ***Visitation and Recreation***

Under alternative B, implementation of management actions, including monitoring, direct reduction with firearms, and fencing, would temporarily create noise from the use of helicopters and/or firearms that could have social effects on visitors, local communities, or adjacent private landowners. However, the use of helicopters is limited typically to one to two hours and confined to specific areas of the park. Fences are generally located away from visitor campsites and most trails or are obscured by dense vegetation, which reduces the potential for visual and aesthetic impacts.

Temporary closures could be used to minimize visitor exposure to management actions, but they also could preclude visitors from accessing an area to engage in desired recreational opportunities. Considering past experience, closures would generally be used infrequently, and the public would be notified of them in advance so they can adjust their plans. Actions may begin in the early morning and continue throughout the day; however, in areas where visitor use is high, actions would typically be limited to the early morning or off-peak hours in order to reduce impacts on visitor use, reducing the frequency and duration of closures. In addition, the entire park would not be closed to the public for management actions. A diversity of key visitor destinations would always be open and available for visitation to accommodate park visitors during any localized temporary closures.

Because temporary impacts from management actions would not appreciably affect visitor satisfaction at the park or cause changes in the number of visitors, alternative B would not affect the contribution that tourism and recreational spending has to local economies.

#### ***Nonmarket Social Values***

Alternative B is expected to have short-term minor adverse impacts on the experiences and perceptions of some residents, visitors, and stakeholders, who may prefer non-lethal relocation approaches over lethal ground and aerial shooting methods and snaring methods. Additionally, visitors and residents who value a quiet, natural experience could be adversely affected in the short term due to temporary closures, noise, and the presence of fencing. As the reduction phase concludes, these adverse effects will decrease as fewer numbers of non-native ungulates will need to be removed by lethal methods.

There may be less interest among some members of the public to participate in direct reduction activities because volunteers would not be able to keep the meat or any part of the animal. However the NPS, would salvage and donate meat when possible, following all applicable public health and government property guidelines. Also, while the volunteer program is popular and enthusiastically supported by local residents, most participants have typically participated only once. Since the park is surrounded by state game and forest reserves, there would remain opportunities available for residents to participate in hunting activities. Therefore, it is expected that the social effects of alternative B would be minor on community residents who would participate in this program. Therefore, it is expected that the social effects of alternative B would continue to have short-term beneficial impacts on community residents who participate in this program.

The non-native ungulate management actions under alternative B would result in long-term benefits to native ecosystems, and support protection of rare, unique, threatened, or endangered species and their habitat in the park that contribute to the park's designation as a biosphere reserve and world heritage site, which attracts visitors from around the world. These benefits would be fully realized under alternative B

because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### ***NPS Spending and Payroll***

Under alternative B, short term, beneficial impacts on local communities are expected as a result of park payroll and spending on fencing and related supplies. In the longer term, as the reduction phase concludes and the park progresses into the maintenance phase, it is possible that fewer expenditures on fencing materials and supplies would reduce these benefits for local communities.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative B would be the same as alternative A. The impacts of past, present, and reasonably foreseeable future actions on socioeconomic resources, when combined with the impacts of implementing alternative B, would have long-term beneficial and short- and long-term minor adverse cumulative impacts. These benefits would be fully realized under alternative B because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Conclusion**

Under alternative B, non-native ungulate management program would have beneficial impacts on local communities as a result of park payroll and spending on non-native ungulate control, fencing, and related supplies. Impacts to non-market social values would be minor, short-term, and adverse during control activities. There would be no measurable effect on park visitation and recreation spending. Long-term beneficial impacts to non-market social values through the restoration of native species and communities would be fully realized under alternative B because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

The impacts of past, present, and reasonably foreseeable future actions on socioeconomic resources, when combined with the impacts of implementing alternative B, would have short- and long-term minor adverse and long-term beneficial cumulative impacts.

## **Alternative C: Comprehensive Management Plan that Maximizes Efficiency by Expanding Lethal Removal Techniques and Discontinuing the Use of Volunteers**

### **Analysis**

#### ***Visitation and Recreation***

Under alternative C, the need for temporary closures for control activities would be reduced, as the reduction phase would be shorter compared to alternative A. Because temporary impacts from management actions would not appreciably affect visitor satisfaction at the park or cause changes in the number of visitors, alternative C would not affect the economic contribution that visitation and recreational spending has to local economies.

### ***Nonmarket Social Values***

Similar to alternative B, visitors and residents who value a quiet, natural experience could be adversely affected in the short term due to temporary closures, noise, and the presence of fencing. Although lethal methods of non-native ungulate control are notably efficient and cost-effective approaches to meeting the objective of zero ungulates on park lands, these lethal methods could be more controversial and less socially acceptable than other non-lethal methods. Alternative C allows for lethal methods, potential expansion of these lethal tools and approaches, and possibly applying these methods to additional species. Therefore, alternative C is expected to have short-term minor adverse impacts on the experience and perceptions of some residents, visitors, and stakeholders, who may prefer non-lethal relocation approaches over lethal ground and aerial shooting methods and snaring methods. As the reduction phase concludes, these adverse effects will decrease as fewer numbers of ungulates will need to be removed by lethal methods.

Under alternative C, the use of volunteers for direct reduction with firearms would not continue. Although the volunteer program is popular and enthusiastically supported by local residents, most participants have typically participated only once (occasionally twice, if the participant is the guest of another participant). Since the park is also surrounded by state game and forest reserves, there are plenty of substitute opportunities available for residents to participate in hunting activities. Therefore, even with no volunteer program available, individuals would still be able to participate in game activities outside the park and obtain meat elsewhere, resulting in minor adverse impacts on the social values.

As the park moves through the reduction phase into the maintenance phase and desired conditions are reached, the threats to native ecosystems posed by non-native ungulates would be substantially decreased. The park would be able to reestablish some of the natural features that attract visitors and enhance the quality of visitors' and residents' experiences. In addition, the frequency of management actions is expected to decrease, and the expected time and resources required to meet ungulate control objectives are also expected to be less, compared to alternative B. As a result, recreational and environmental values are likely to be beneficially affected by management activities under alternative C in the long term.

### ***NPS Spending and Payroll***

Under alternative C, the socioeconomic impacts of the non-native ungulate management program are expected to be similar to those of alternative A, as fencing and other supplies will be needed for the management activities, and park employment is not expected to change. Therefore, long-term beneficial effects on local communities would continue under alternative C as a result of park payroll and spending on fencing and related supplies. Resources previously allocated to administering the Volunteer Ungulate Control Program, would be redirected to monitoring, and reduction efforts, which could expedite the time to reach the maintenance phase. It is possible that fewer expenditures on fencing materials and supplies could occur as the park moves to the maintenance phase in new areas, which may reduce the beneficial impacts on local communities over time.

### ***Cumulative Impacts***

The past, present, and reasonably foreseeable future actions under alternative C would be the same as alternative A. Similar to alternative B, the impacts of past, present, and reasonably foreseeable future actions on socioeconomic resources, when combined with the impacts of implementing alternative C, would have short- and long-term minor adverse and long-term beneficial cumulative impacts.

## Conclusion

Alternative C would have no measurable effect on park visitation and recreation values. Impacts to non-market social values would be minor, short-term, and adverse during control activities, and long-term and beneficial over the long-term. Impacts on participants in the volunteer program are expected to be minor, as substitute hunting opportunities are available. Beneficial effects from NPS spending and payroll would be short- and long-term. Resources previously allocated to administering the Volunteer Ungulate Control Program, would be redirected to monitoring, and reduction efforts, which could expedite the time to reach desired conditions. Overall, there would be short-term minor adverse impacts, and long-term beneficial impacts on socioeconomics in the area. The impacts of past, present, and reasonably foreseeable future actions on socioeconomic resources, when combined with the impacts of implementing alternative C, would have short- and long-term minor adverse and long-term beneficial cumulative impacts.

## Alternative D: Comprehensive Management Plan that Maximizes Flexibility of Management Techniques

### Analysis

#### *Visitation and Recreation*

Under alternative D, the socioeconomic impacts on local economies associated with visitation and recreational spending would be the same as those of alternative B. Because temporary impacts from management actions would not appreciably affect visitor satisfaction at the park or cause changes in the number of visitors, there would be no effect on the contribution of visitation and recreational spending to local economies.

#### *Nonmarket Social Values*

Similar to alternative B, the social effects of alternative D on visitors' and residents' recreational and environmental values are expected to be short-term minor adverse and long term beneficial.

Although lethal methods (e.g., ground and aerial shooting methods and snaring) of ungulate control are notably efficient and cost-effective approaches to meeting the objective of zero ungulates in park lands, these lethal methods could be more controversial and less socially acceptable than other, non-lethal, methods. Alternative D allows for both lethal and non-lethal methods. If the park implements non-lethal control methods where possible, this may be perceived by some stakeholders as more acceptable than the current program under alternative A. Therefore, alternative D is expected to have short-term negligible to minor adverse impacts on the perceptions of some residents, visitors, and stakeholders, who may prefer non-lethal relocation approaches over lethal methods. Conversely, the additional resources needed to implement non-lethal methods (e.g., relocation of animals) may delay the NPS in reaching desired conditions and result in more reduction efforts, which would contribute to adverse impacts to social values. As the reduction phase concludes, these adverse effects will decrease as fewer numbers of ungulates will need to be removed by lethal methods.

#### *NPS Spending and Payroll*

Similar to alternative B, beneficial impacts on local communities are expected as a result of spending on fencing and related supplies. In the long term, as the reduction phase concludes and the park progresses into the maintenance phase, it is possible that fewer expenditures on fencing materials and supplies would reduce these benefits for local communities. Under alternative D, the park may take longer to reach the

maintenance phase, as resources would be redirected to exploring non-lethal methods of control (including relocation of animals) which may delay the NPS in reaching desired conditions.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative D would be the same as alternative A. Similar to alternative B, the impacts of past, present, and reasonably foreseeable future actions on socioeconomic resources, when combined with the impacts of implementing alternative D, would have short- and long-term minor adverse and long-term beneficial cumulative impacts.

### **Conclusion**

Alternative D would have no measurable effect on park visitation and recreation values. Impacts to non-market social values would be minor, short-term, and adverse during control activities, and long-term and beneficial over the long-term. Some beneficial impacts to social values would be gained among individuals who prefer non-lethal relocation approaches over lethal methods. Conversely, the additional resources needed to implement non-lethal methods (e.g., relocation of animals) may delay the NPS in reaching desired conditions and result in more reduction efforts, which would contribute to adverse impacts to social values. Beneficial effects from NPS spending and payroll would be short- and long-term. Overall, there would be short-term minor adverse impacts, and long-term beneficial impacts on socioeconomics in the area. The impacts of past, present, and reasonably foreseeable future actions on socioeconomic resources, when combined with the impacts of implementing alternative D, would have short- and long-term minor adverse and long-term beneficial cumulative impacts.

## **Alternative E: Comprehensive Management Plan that Increases Flexibility of Management Techniques While Limiting the Use of Volunteers**

### **Analysis**

#### ***Visitation and Recreation***

Under alternative E, the socioeconomic impacts on local economies associated with visitation and recreational spending would be the same as those of alternative D. Because temporary impacts from management actions would not appreciably affect visitor satisfaction at the park or cause changes in the number of visitors, there would be no effect on the contribution of visitation and recreational spending to local economies.

#### ***Nonmarket Social Values***

Similar to alternative D, the social effects of alternative E on visitors' and residents' recreational and environmental values are expected to be short-term minor adverse and long term beneficial.

Under alternative E, the Volunteer Ungulate Control Program would continue, although volunteers would not be used for direct reduction with firearms. While the majority of volunteer interest among local residents has been in participation with ground shooting efforts, most participants have typically participated only once (occasionally twice, if the participant is the guest of another participant). Consequently, the modification is not expected to cause adverse impacts on residents since other game and forest reserves are available for hunting opportunities. Individuals will still be able to participate in game activities outside the park and obtain meat elsewhere, with minor adverse impacts on the social values.

### ***NPS Spending and Payroll***

Similar to alternative D, beneficial impacts on local communities are expected as a result of spending on fencing and related supplies. In the long term, as the reduction phase concludes and the park progresses into the maintenance phase, it is possible that fewer expenditures on fencing materials and supplies would reduce these benefits for local communities.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative E would be the same as alternative A. Similar to alternative B, the impacts of past, present, and reasonably foreseeable future actions on socioeconomic resources, when combined with the impacts of implementing alternative E, would have short- and long-term minor adverse and long-term beneficial cumulative impacts.

### **Conclusion**

Similar to all action alternatives, alternative E would have no measurable effect on park visitation and recreation values. Impacts to non-market social values would be minor, short-term, and adverse during control activities, and long-term and beneficial over the long-term. Similar to alternative D, some beneficial impacts to social values would be gained among individuals who prefer non-lethal relocation approaches over lethal methods. Conversely, the additional resources needed to implement non-lethal methods (e.g., relocation of animals) may delay the NPS in reaching desired conditions and result in more reduction efforts, which would contribute to adverse impacts to social values. Impacts on the volunteer program participants are expected to be minor, as substitute hunting opportunities are readily available. Beneficial effects from NPS spending and payroll would be short- and long-term. Resources previously allocated to administering volunteer ground shooting efforts, would be redirected to monitoring, and reduction efforts, which could expedite the time to reach desired conditions. Overall, there would be short-term minor adverse impacts, and long-term beneficial impacts on socioeconomics. The impacts of past, present, and reasonably foreseeable future actions on socioeconomic resources, when combined with the impacts of implementing alternative E, would have short- and long-term minor adverse and long-term beneficial cumulative impacts.

## **VISITOR USE AND EXPERIENCE**

### **GUIDING REGULATIONS AND POLICIES**

The NPS *Management Policies 2006* (NPS 2006b) states 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.

The importance of visitor use and experience is highlighted in Hawai‘i Volcanoes National Park’s foundation statement, which states that the park “protects, studies, and provides access to Kīlauea and Mauna Loa, two of the world’s most active volcanoes; and perpetuates endemic Hawaiian ecosystems and the traditional Hawaiian culture connected to these landscapes” (NPS 2010a). The value of the visitor experience is also stated in the park’s significance statement, which emphasizes the variety of natural and cultural resource experiences that the park provides to visitors. These include opportunities to experience diverse ecosystems that are the result of over 30 million years of evolution, wide climate variation, and the extreme isolation of the Hawaiian Islands. Furthermore, the international biosphere reserve designation, conferred in 1980, recognizes the park’s long-term commitment to scientific study, monitoring, and the protection of the range of unique tropical forests and woodlands. The world heritage

designation, conferred in 1986, is based on the “on-going geologic processes of volcanism, of endemic and native biota and human interrelationships with the lands” (UNESCO 1987).

While preservation and conservation are key components of the NPS *Management Policies 2006*, it also instructs 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 recreational activities compatible with such efforts.

## **METHODOLOGY, ASSUMPTIONS, AND IMPACT THRESHOLDS**

Past visitor use data, comments from the public, and personal observations of visitation patterns were used to estimate the effects of the alternative actions on visitors. It is assumed that annual recreational visitation over the life of the plan will remain relatively steady at about 1.3 million recreational visitors per year, with slight variations from year to year (NPS 2009b). Impact intensity thresholds were defined for adverse impacts. For this plan/EIS, assignment of intensity levels for visitor use and experience impacts are based on the potential for changes to such characteristics as follows:

- Negligible:* The impact would be barely detectable and/or would affect few visitors. Visitors would not likely be aware of the effects associated with management actions.
- Minor:* The impact would be detectable and/or would affect some visitors. Visitors would likely be aware of the effects associated with management actions. The changes in visitor use and experience would be slight but detectable; however, visitor satisfaction would not be measurably affected.
- Moderate:* The impact would be readily apparent and/or would affect many visitors. Visitors would be aware of the effects associated with management actions. Visitor satisfaction might be measurably affected. Some visitors may choose to pursue activities in other available local or regional areas.
- Major:* The impact would affect the majority of visitors. Visitors would be highly aware of the effects associated with management actions, and visitor satisfaction could decrease substantially. Changes in visitor use and experience would be readily apparent. Some visitors would choose to pursue activities in other available local or regional areas.

## **IMPACTS OF THE ALTERNATIVES**

### **Alternative A: No Action (Continue Existing Non-native Ungulate Management Activities)**

#### **Analysis**

Implementation of management actions, including monitoring, direct reduction with firearms, and fencing, would temporarily create noise from the use of helicopters and/or firearms that could affect visitor use and experience. However, the use of helicopters is limited: aerial monitoring and shooting operations, last a matter of hours, and are confined to specific areas. While ground shooting operations could last up to 12 hours, shooting activities are not continuous, and all management actions are confined to specific areas and, as much as possible, conducted during early morning hours to minimize impacts on visitors as well as increase efficiency of control efforts. Similarly, monitoring activities and fence construction/involving the use of helicopters are also intermittent. In addition, fences are generally

located away from visitor campsites and most trails or are obscured by dense vegetation, which reduces the potential for visual impacts.

Temporary closures could be used to minimize visitor exposure to such impacts, but they also could preclude visitors from accessing an area to engage in desired recreational opportunities. The Kahuku unit is currently open to visitors on weekends from 9:00 a.m. to 3:00 p.m., but closures in this area could occur due to non-native ungulate management actions. Temporary closures may be necessary in portions of the Kīlauea, Mauna Loa Strip, and ‘Ōla‘a sections of the park. These are typically very limited in number and based largely on the amount of animal ingress detected in managed units. In addition to the temporary closures to minimize visitor exposure to removal operations, the park typically limits the removal to the early mornings and off-peak hours. In addition, the entire park would not be closed to the public for management actions. A diversity of key visitor destinations would always be open and available for visitation to accommodate park visitors during any localized temporary closures. Judging by past experience, closures would generally be used infrequently, and the public would be notified of them in advance so they can adjust their plans.

Fencing could result in adverse impacts on visitor use and experience for those who do not want to see such structures in natural environments. However, as noted previously, fences are generally located away from visitor campsites and most trails or are obscured by dense vegetation.

Ungulate exclusion and removal would support native ecosystems recovery, vegetation, and efforts to restore rare species, and the park would be able to reestablish some of the natural features that attract visitors and enhance their experience. In addition, the park would continue to provide information about non-native ungulates in the visitor center and programs conducted in local schools and communities. These educational and interpretive programs increase public awareness and understanding of non-native ungulate impacts to park resources and the need for park actions.

In summary, alternative A would result in short- and long-term minor adverse effects on visitor use and experience through temporary closures and disruptions caused by ungulate control measures and fence construction and repair, and the long-term presence of fences. In the older section of the park, long-term beneficial impacts to the visitor experience resulting from the recovery of native vegetation and wildlife habitat would continue in managed units. However, long-term benefits would be less likely for Kahuku and areas unmanaged (e.g., portions of ‘Ōla‘a), for which no established population-level objective and fencing strategy has been identified. Also, the implementation of management tools and monitoring would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities. Because alternative A would not incorporate the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, it would be less likely that the NPS would progress through management phases, monitor, and apply management tools consistently as staff and institutional knowledge change over time.

### **Cumulative Impacts**

Many past, present, and reasonably foreseeable future actions, plans, and programs at the park would contribute to beneficial effects on visitor use and experience. The acquisition of new lands (including Kahuku) would provide for an increased diversity of areas for visitors to use and experience, and could also alleviate crowding in other sections of the park. Park educational programs and interpretation activities increase visitors’ awareness of the ecosystems in the park, as well as the cultural importance of the park. Law enforcement activities and other management actions would continue to keep visitors safe from criminal activity and personal injury by restricting dangerous areas of the park (lava flows, etc.). Rare and sensitive species restoration activities (including the implementation of USFWS recovery plans) would continue to provide increased habitat for sensitive native species found in the park, which would

provide more opportunities for visitors to see these species, augmenting their appreciation for native Hawaiian plants and wildlife. The development and subsequent implementation of the GMP and the wilderness management plan would provide for increased management actions throughout the entire park that meet the needs of the various visitors and visitor activities found at the park, including in wilderness areas. The development and subsequent implementation of the ATMP would dictate how, where, and how often aerial tours may take place above the park, while taking into account soundscapes and visitor experience. The implementation of the *Ala Kahakai National Historic Trail Management Plan* (NPS 2004d) would provide visitors with increased hiking opportunities inside and outside the park. Restoration of native plant communities inside the park would provide increased habitat for sensitive vegetation species found in the park, which would provide more opportunities for visitors to experience the native flora. The proposed Mauna Loa trail system, could provide visitors with increased recreational activities and would increase awareness of the island's unique natural and cultural resources.

There are also some past, current, and future actions that would contribute to adverse cumulative effects on visitor use and experience. Temporary closures in the park due to volcanic activity can potentially impact visitor use and experience adversely if visitors are not able to access desirable locations in the park. Increased aviation activities inside and outside the park can create excessive noise from overflights, negatively impacting visitor experience. Visitation in the park could have adverse impacts on visitor experience due to the potential of overcrowding in certain locations, traffic delays, and a reduced sense of solitude in the park.

Some past, current, and future actions contribute to both beneficial and adverse impacts, depending on what stage of implementation they are in. For example, development in the park would have adverse impacts on visitor use and experience during the construction phase due to access closures and impacts from noise; however, once construction is complete, visitors would experience beneficial impacts due to increased and/or improved facilities at the park, such as roads and visitor centers. The change in the fire ecology due to habitat fragmentation and non-native species can negatively alter the landscape and create more fire-susceptible areas in the park; however, fire management would implement measures to protect human life, property, and cultural resources, as well as maintaining or restoring natural resources.

These past, present, and reasonably foreseeable future actions would have short- and long-term minor adverse impacts on visitor use and experience, as well as long-term beneficial effects. Past, present, and reasonably foreseeable future actions, when combined with the impacts of alternative A, would have short- and long-term minor adverse impacts and long-term beneficial cumulative impacts on visitor use and experience. Long-term beneficial cumulative impacts would be less likely under alternative A, because non-native ungulate management within the park would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

## **Conclusion**

Under alternative A, short- and long-term minor adverse effects on visitor use and experience would result from temporary closures and disruptions caused by ungulate control measures and fence construction and repair, and the long-term presence of fences. In the older section of the park, long-term beneficial impacts to the visitor experience resulting from the recovery of native vegetation and wildlife habitat would continue in managed units. Long-term beneficial impacts would be less likely for the Kahuku unit and areas currently unmanaged (e.g., portions of 'Ōla'a), where no established population-level objective or fencing strategy has been identified in a comprehensive and systematic plan. The effects of alternative A, when combined with impacts of past, present, and reasonably foreseeable future actions on visitor use and experience, would have short- and long-term minor adverse cumulative impacts. Long-

term beneficial cumulative impacts would be less likely under alternative A, because non-native ungulate management would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

**Alternative B: Comprehensive Management Plan that Uses Lethal Removal Techniques**

**Analysis**

Under alternative B, short- and long-term minor adverse effects on visitor use and experience would result from temporary closures and disruptions caused by ungulate control measures and fence construction and repair, and the long-term presence of fences. However, the use of helicopters is limited for aerial monitoring and shooting operations which last a matter of hours, and both ground and aerial shooting operations are confined to specific areas. As much as possible, actions are conducted during early morning hours to minimize impacts on visitors as well as increase efficiency of control efforts. Similarly, monitoring activities and fence construction involving the use of helicopters are also intermittent. In addition, fences are generally located away from visitor campsites and most trails or are obscured by dense vegetation, which reduces the potential for visual impacts.

Temporary closures could be used to minimize visitor exposure to such impacts, but they also could preclude visitors from accessing an area to engage in desired recreational opportunities. These closures are typically very limited in number (see the “Frequency and Duration of Management Actions” section in chapter 2). In addition, the park typically limits the removal to the early mornings and off-peak hours.

In addition, the entire park would not be closed to the public for management actions. A diversity of key visitor destinations would always be open and available for visitation to accommodate park visitors during any localized temporary closures. Judging by past experience, closures would generally be used infrequently, and the public would be notified of them in advance so they can adjust their plans. Additionally, as the park moves from the reduction phase to the maintenance phase, it is expected that fewer closures would be needed.

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*A diversity of key visitor destinations would always be open and available for visitation to accommodate park visitors during any localized temporary closures. Judging by past experience, closures would generally be used infrequently, and the public would be notified of them in advance so they can adjust their plans.*

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Fencing could result in adverse impacts on visitor use and experience for those who do not want to see such structures in natural environments. However, as noted previously, fences are generally located away from visitor campsites and most trails or are obscured by dense vegetation.

Ungulate exclusion and removal would support native ecosystems recovery, vegetation, and efforts to restore rare species. Once desired conditions are reached, the threats to native ecosystems posed by non-native ungulates would be substantially decreased, and the park would be able to reestablish some of the natural features that attract visitors and enhance their experience. In addition, the implementation of a comprehensive plan would provide a framework for the development of interpretive programs aimed towards enhancing visitor awareness and understanding of non-native ungulate management actions and why they are necessary for the protection of park resources.

As a result, there would be long-term beneficial and short- and long-term minor adverse effects on visitor use and experience under alternative B. These benefits would be fully realized under alternative B

because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative B would be the same as alternative A. The short-term and long-term minor adverse and long-term beneficial impacts of past, present, and reasonably foreseeable future actions on visitor use and experience, when combined with the impacts of implementing alternative B, would have short- and long-term minor adverse and long-term beneficial cumulative impacts. Long-term beneficial impacts to visitor use and experience would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### **Conclusion**

Under alternative B, short- and long-term minor adverse effects on visitor use and experience would result from temporary closures and disruptions caused by ungulate control measures and fence construction and repair, and the long-term presence of fences. Long-term beneficial impacts to visitor use and experience would be fully realized under this alternative because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

The effects of alternative B, when combined with impacts of past, present, and reasonably foreseeable future actions on visitor use and experience, would have short- and long-term minor adverse cumulative and long-term beneficial impacts.

## **Alternative C: Comprehensive Management Plan that Maximizes Efficiency by Expanding Lethal Removal Techniques and Discontinuing the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative C would result in short- and long-term minor adverse effects on visitor use and experience through temporary closures and disruptions caused by ungulate control measures and fence construction and repair, and the long-term presence of fences. Long-term beneficial impacts to visitor use and experience would be fully realized under alternative C.

Because lethal techniques would be expanded and enhanced, and volunteers would not be used during direct reduction efforts under alternative C, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative B. The increased efficiency associated with discontinuing the use of volunteers is based on additional work required by NPS staff to recruit, administer, train and direct volunteers in the field, and data that show that park staff remove more ungulates per day when they conduct direct reduction (ground shooting) themselves, compared to when they are accompanied by volunteers (Stephens et al. 2008). Therefore, fewer reduction activities would result when compared to alternative B.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative C would be the same as alternative A. Similar to alternative B, the long-term beneficial and short- and long-term minor adverse impacts of past, present, and reasonably foreseeable future actions, when combined with the impacts of implementing alternative C, would have long-term beneficial and short- and long-term minor adverse cumulative impacts on visitor use and experience.

### **Conclusion**

Under alternative C, short- and long-term minor adverse effects on visitor use and experience would result from temporary closures and disruptions caused by ungulate control measures and fence construction and repair, and the long-term presence of fences. Long-term beneficial impacts to visitor use and experience would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative C than under alternative B. The effects of alternative C, when combined with impacts of past, present, and reasonably foreseeable future actions on visitor use and experience, would have short- and long-term minor adverse cumulative and long-term beneficial impacts.

## **Alternative D: Comprehensive Management Plan that Maximizes Flexibility of Management Techniques**

### **Analysis**

Similar to alternative B, alternative D would result in short- and long-term minor adverse effects on visitor use and experience through temporary closures and disruptions caused by ungulate control measures and fence construction and repair, and the long-term presence of fences. Long-term beneficial impacts to visitor use and experience would be fully realized under alternative D.

Although the expansion and enhancement of lethal removal techniques under alternative D would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the continued use of volunteers and the expansion of non-lethal techniques would counteract this to some extent. Inclusion of non-lethal removal would require additional staff time and park resources to relocate animals to adjacent lands, and may increase the time associated with reduction actions over the life of the plan, as well as time needed to reach the post-reduction phase. As a result, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative D would be the same as alternative A. Similar to alternative B, the long-term beneficial and short- and long-term minor adverse impacts of past, present, and reasonably foreseeable future actions, when combined with the impacts of implementing alternative D, would have long-term beneficial and short- and long-term minor adverse cumulative impacts on visitor use and experience.

### **Conclusion**

Under alternative D, short- and long-term minor adverse effects on visitor use and experience would result from temporary closures and disruptions caused by ungulate control measures and fence construction and repair, and the long-term presence of fences. Long-term beneficial impacts to visitor use

and experience would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly under alternative D than under alternative C. The effects of alternative D, when combined with impacts of past, present, and reasonably foreseeable future actions on visitor use and experience, would have short- and long-term minor adverse cumulative and long-term beneficial impacts.

### **Alternative E: Comprehensive Management Plan that Increases Flexibility of Management Techniques While Limiting the Use of Volunteers**

#### **Analysis**

Similar to alternative B, alternative E would result in short- and long-term minor adverse effects on visitor use and experience through temporary closures and disruptions caused by ungulate control measures and fence construction and repair, and the long-term presence of fences. Long-term beneficial impacts to visitor use and experience would be fully realized under alternative E.

Although the expansion and enhancement of lethal removal techniques under alternative E would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the expansion of non-lethal techniques would counteract this to some extent. However, because volunteers would not be used during direct reduction efforts under alternative E, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative D, but less quickly than under alternative C.

#### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative E would be the same as alternative A. Similar to alternative B, the long-term beneficial and short- and long-term minor adverse impacts of past, present, and reasonably foreseeable future actions, when combined with the impacts of implementing alternative E, would have long-term beneficial and short - and long-term minor adverse cumulative impacts on visitor use and experience.

#### **Conclusion**

Under alternative E, short- and long-term minor adverse effects on visitor use and experience would result from temporary closures and disruptions caused by ungulate control measures and fence construction and repair, and the long-term presence of fences. Long-term beneficial impacts to visitor use and experience would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative E than under alternative D, but less quickly than under alternative C. The effects of alternative E, when combined with impacts of past, present, and reasonably foreseeable future actions on visitor use and experience, would have short- and long-term minor adverse cumulative and long-term beneficial impacts.

## **VISITOR AND EMPLOYEE SAFETY**

### **GUIDING REGULATIONS AND POLICIES**

The NPS *Management Policies 2006* states 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 NPS *Management Policies 2006* also states that “the Service will reduce or remove known hazards and apply other appropriate measures, including closures, guarding, signing, or other forms of education” (NPS 2006b, Section 8.2.5.1).

## METHODOLOGY, ASSUMPTIONS, AND IMPACT THRESHOLDS

The purpose of this impact analysis is to identify the level of impact that implementing each of the proposed alternatives would have on the safety of visitors and employees at Hawai'i Volcanoes National Park.

Impact intensity thresholds were defined for adverse impacts. For this plan/EIS, assignment of intensity levels for visitor and employee safety impacts are based on the potential for changes to such characteristics as follows:

- Negligible:* There would be no discernible effects on visitor or employee safety; slight injuries could occur.
- Minor:* Any visitor injury would require first aid that could be provided by park staff. Injuries to employees may require a doctor's attention.
- Moderate:* Any visitor or employee injury would require further medical attention beyond what is available at the park. Injuries to employees would result in time off.
- Major:* An employee or visitor injury would result in permanent disability or death.

## IMPACTS OF THE ALTERNATIVES

### Alternative A: No Action (Continue Existing Non-native Ungulate Management Activities)

#### Analysis

The use of firearms and helicopters during direct reduction activities, including the use of helicopters for monitoring and fencing, would pose the greatest safety risk to staff, including qualified volunteers, and other authorized agents. Personnel involved would have the appropriate skills and proficiencies in helicopter operation and in the use of firearms for the removal of wildlife. These skills would reduce the chances that an accident would occur.

Qualified volunteers would be used for direct reduction with firearms in more accessible areas and where animals are abundant (i.e., Kahuku areas below 5,000 feet in elevation (1,524 meters)). This minimizes safety risks associated with accessing difficult or remote terrain. Other safety concerns related to the use of qualified volunteers during direct reduction by firearms are addressed in part by the requirements for becoming a volunteer, which include completing a registration form, obtaining a hunter education certificate or card, presenting a registration of the firearm to be used and a Hawai'i hunting license, and being able to spend a minimum of 8 hours hiking over rough terrain. With these measures in place, the possibility of having issues related to the safety of both the volunteers and the staff engaging in management activities would be reduced. NPS employees would directly supervise and escort volunteers; these staff members would direct volunteers as to which animals should be removed. Park employees would help decrease the chances of an accident occurring because they are trained in firearm use and ungulate management. Also, areas where volunteers are used for ground shooting efforts are temporarily closed to the public to avoid risks to visitors.

Encounters with animals during any management action (especially snaring, baiting, and trapping, which require handling ungulates) would expose staff and qualified volunteers to potential health and safety risks, such as physical harm from kicks and bites, or possibly disease. The park conducts a job hazard

analysis to identify potential safety hazards and implements corrective measures to minimize risks to staff and volunteers.

Visitors could also be exposed to health and safety risks during implementation of management actions that use firearms or snares. Measures to minimize visitor exposure include conducting management actions during early morning hours, off-peak visitation times, or closing an area for the duration of the management activity. Snares are typically used in more remote areas, where visitation is low, and are mapped, flagged and signs posted.

As evidenced by data over the last 5 years (described in the “Visitor and Employee Safety” section in chapter 3), the measures in place limit the potential effects on employee (and qualified volunteer) health and safety to physical environmental hazards and accidents associated with routine field activities (e.g., sprains, cuts, and broken bones from hiking, lifting, moving, and/or operating equipment, materials, or debris; insect stings; exposure to plants; and exposure to disease). Some of these incidents have required time off and medical attention beyond what could be provided at the park. Data from 1992 through 2002 (described in the “Visitor and Employee Safety” section in chapter 3) also show that there have been no visitor incidents related to non-native ungulate management activities. As a result, there would be short-term minor to moderate adverse impacts on health and safety during implementation of management actions. As the number of ungulates are reduced, the frequency and duration of management actions, as well as the associated health and safety risks, would decrease.

The presence of non-native ungulates in the park creates a potential safety hazard for visitors and employees (e.g., potential for wildlife–vehicle collisions, potential for interactions that could result in physical harm) from encounters with these animals during routine operations or activities (e.g., when hiking or driving in the park). Similarly, non-native ungulates have been known to carry diseases that are transmissible to humans. For example, feral swine can harbor at least 30 significant viral and bacteriological diseases, several of which are transmissible to humans (Seward et al. 2003). However, as described in chapter 3, data on employee and visitor incidents do not indicate that any such encounters or disease transmittals have occurred in recent years. With the exception of Kahuku, most areas frequented by park visitors are ungulate free or have very low numbers of ungulates. Ungulates also create suitable habitat for mosquitoes, which potentially can carry diseases transmissible to humans. In Kahuku the potential for human encounters with feral dogs that are attracted to mouflon would be reduced through non-native ungulate removal and fencing. Additionally, as desired conditions are reached, the potential for ungulate encounters would be minimized, as would the creation of mosquito habitat.

In summary, alternative A would result in short-term minor to moderate adverse impacts on visitor and employee safety. In the older section of the park, long-term beneficial impacts to visitor and employee safety would continue in managed units. However, long-term benefits of removing animals would be unlikely for Kahuku and areas currently unmanaged (e.g., portions of ‘Ōla‘a), for which no established population-level objective and fencing strategy has been identified. Also, the implementation of management tools and monitoring would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities. Because alternative A would not incorporate the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2, it would be less likely that the NPS would progress through management phases, monitor, and apply management tools consistently as staff and institutional knowledge change over time. Because of this uncertainty, animals could potentially remain on the landscape indefinitely, increasing exposure of employees and visitors to safety risks associated with ungulate management activities.

## Cumulative Impacts

Other past, present, and reasonably foreseeable and future actions would contribute beneficially to the health and safety of park visitors and employees. The GMP, ATMP, *Ala Kahakai National Historic Trail Management Plan*, the proposed Mauna Loa trail system (an ongoing feasibility study) would develop objectives and, through plan implementation, address visitor and employee safety. Also, fire management inside and outside the park and at the wildland/urban interface would benefit health and safety, as large-scale fire events would be managed to reduce these risks.

There are some past, current, and future actions that would contribute adverse effects to visitor and employee safety. For example, development inside the park, trail maintenance, cultural and natural resources monitoring in the field, and native and non-native plant and animal species management inside the park all pose safety risks for those employees and volunteers conducting these activities, such as accidents with machinery and other inherent risks associated with manual labor and working outdoors. Aviation activities have risks (e.g., potential for crashes) inside and outside the park. While aviation accidents rarely occur, due to the volcanic activity in the park, vog (volcanic smog) reduces air visibility, creating a hazard for air traffic. The acquisition of new lands would require additional management and would eventually provide new visitor use areas. The routine fieldwork and visitor uses in these areas could increase the potential for accidents and injuries. Law enforcement activities would contribute to beneficial impacts by protecting visitors from being injured (by wandering off designated trails or through encounters with wildlife), but could also contribute to adverse impacts on employee safety should law enforcement officials become injured while performing their duties.

These past, present, and reasonably foreseeable future actions would have short- and long-term minor to moderate adverse and long-term beneficial impacts on visitor and employee safety. Past, present, and reasonably foreseeable future actions, when combined with the short-term minor to moderate adverse impacts and long-term beneficial effects on visitor and employee safety of alternative A, would have short- and long-term minor to moderate adverse cumulative impacts on visitor and employee safety. Long-term beneficial cumulative impacts would be less likely under alternative A, because non-native ungulate management within the park would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

## Conclusion

Under alternative A, short- and long-term minor to moderate adverse impacts on visitor and employee safety would result from implementation of management actions. In the older section of the park, long-term beneficial impacts to visitor and employee safety would continue in managed units. Long-term beneficial impacts would be unlikely for the Kahuku unit and areas currently unmanaged (e.g., portions of ‘Ōla‘a), where no established population-level objective or fencing strategy has been identified in a comprehensive and systematic plan. The effects of alternative A, when combined with impacts of past, present, and reasonably foreseeable future actions on visitor and employee safety, would have short- and long-term minor to moderate adverse cumulative impacts. Long-term beneficial cumulative impacts would be less likely under alternative A, because non-native ungulate management would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time.

## **Alternative B: Comprehensive Management Plan that Uses Lethal Removal Techniques**

### **Analysis**

Under alternative B there would be short- and long-term minor to moderate adverse impacts on visitor and employee safety through implementation of management actions.

The use of firearms and helicopters during direct reduction activities, including the use of helicopters for monitoring and fencing, would pose the greatest safety risk to staff, including qualified volunteers, and other authorized agents. Personnel involved would have the appropriate skills and proficiencies in helicopter operation and in the use of firearms for the removal of wildlife. These skills would reduce the chances that an accident would occur.

Qualified volunteers would be used for direct reduction with firearms during the reduction phase in more accessible areas of Kahuku (i.e., areas below 5,000 feet in elevation (1,524 meters)). This minimizes safety risks associated with accessing difficult or remote terrain. Other safety concerns related to the use of qualified volunteers during direct reduction by firearms are addressed in part by the requirements for becoming a volunteer, which include completing a registration form, obtaining a hunter education certificate or card, presenting a registration of the firearm to be used and a Hawai'i hunting license, and being able to spend a minimum of 8 hours hiking over rough terrain. With these measures in place, the possibility of having issues related to the safety of both the volunteers and the staff engaging in management activities would be reduced. NPS employees would directly supervise and escort volunteers; these staff members would direct volunteers as to which animals should be removed. Park employees would help decrease the chances of an accident occurring because they are trained in firearm use and ungulate management. Also, areas where volunteers are used for ground shooting efforts are temporarily closed to the public to avoid risks to visitors.

Encounters with animals during any management action (especially snaring, baiting, and trapping, which require handling ungulates) would expose staff and qualified volunteers to potential health and safety risks, such as physical harm from kicks and bites, or possibly disease. The park conducts a job hazard analysis to identify potential safety hazards and implements corrective measures to minimize risks to staff and volunteers.

Visitors could also be exposed to health and safety risks during implementation of management actions that use firearms or snares. Measures to minimize visitor exposure include conducting management actions during early morning hours, off-peak visitation times, or closing an area for the duration of the management activity. Snares are typically used in more remote areas, where visitation is low, and are mapped, flagged and signs posted.

As evidenced by data over the last 5 years (described in the “Visitor and Employee Safety” section in chapter 3), the measures in place limit the potential effects on employee (and qualified volunteer) health and safety to physical environmental hazards and accidents associated with routine field activities (e.g., sprains, cuts, and broken bones from hiking, lifting, moving, and/or operating equipment, materials, or debris; insect stings; exposure to plants; and exposure to disease). Some of these incidents have required time off and medical attention beyond what could be provided at the park. Data from 1992 through 2002 (described in the “Visitor and Employee Safety” section in chapter 3) also show that there have been no visitor incidents related to non-native ungulate management activities. As a result, there would be short-term minor to moderate adverse impacts on health and safety during implementation of management actions. As the park moves from the reduction phase to the maintenance phase, the frequency and duration of management actions, as well as the associated health and safety risks, would decrease.

The presence of non-native ungulates in the park creates a potential safety hazard for visitors and employees (e.g., potential for wildlife–vehicle collisions, potential for interactions that could result in physical harm) from encounters with these animals during routine operations or activities (e.g., when hiking or driving in the park). Similarly, non-native ungulates have been known to carry diseases that are transmissible to humans. For example, feral swine can harbor at least 30 significant viral and bacteriological diseases, several of which are transmissible to humans (Seward et al. 2003). However, as described in chapter 3, data on employee and visitor incidents do not indicate that any such encounters or disease transmittals have occurred in recent years. With the exception of Kahuku, most areas frequented by park visitors are ungulate free or have very low numbers of ungulates. Ungulates also create suitable habitat for mosquitoes, which potentially can carry diseases transmissible to humans. In Kahuku the potential for human encounters with feral dogs that are attracted to mouflon would be reduced through non-native ungulate removal and fencing. Additionally, as desired conditions are reached, the potential for ungulate encounters would be minimized, as would the creation of mosquito habitat.

In summary, alternative B would result in short-term minor to moderate adverse impacts on visitor and employee safety and long-term beneficial impacts through removing the potential safety hazard for visitors and employees from encounters with non-native ungulates, and reducing habitat for mosquitoes, which potentially can carry diseases transmissible to humans. These benefits would be fully realized under alternative B because the comprehensive, systematic approach described in the “Elements Common to All Action Alternatives” section in chapter 2 would ensure that the NPS would progress through ungulate management phases, monitor, and apply management tools consistently over time.

### ***Cumulative Impacts***

The past, present, and reasonably foreseeable future actions under alternative B would be the same as alternative A. The short- and long-term minor to moderate adverse and long-term beneficial impacts of past, present, and reasonably foreseeable future actions on visitor and employee safety, when combined with the impacts of implementing alternative B, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts on visitor and employee safety in the park.

### **Conclusion**

Under alternative B, short- and long-term minor to moderate adverse impacts on visitor and employee safety would result from implementation of management actions. Long-term beneficial impacts to visitor and employee safety would be fully realized under this alternative. The effects of alternative B, when combined with impacts of past, present, and reasonably foreseeable future actions on visitor and employee safety, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

## **Alternative C: Comprehensive Management Plan that Maximizes Efficiency by Expanding Lethal Removal Techniques and Discontinuing the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative C would result in short- and long-term minor to moderate adverse impacts on visitor and employee safety through implementation of management actions. Long-term beneficial impacts to visitor and employee safety would be fully realized under alternative C.

Because lethal techniques would be expanded and enhanced, and volunteers would not be used during direct reduction efforts under alternative C, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative B. The

increased efficiency associated with discontinuing the use of volunteers is based on additional work required by NPS staff to recruit, administer, train and direct volunteers in the field, and data that show that park staff remove more ungulates per day when they conduct direct reduction (ground shooting) themselves, compared to when they are accompanied by volunteers (Stephens et al. 2008). Therefore, fewer reduction activities would result when compared to alternative B.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative C would be the same as alternative A. Similar to alternative B, when combined with the impacts of implementing alternative C, there would be short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts on visitor and employee safety in the park.

### **Conclusion**

Under alternative C, short- and long-term minor to moderate adverse impacts on visitor and employee safety would result from implementation of management actions. Long-term beneficial impacts to visitor and employee safety would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative C than under alternative B. The effects of alternative C, when combined with impacts of past, present, and reasonably foreseeable future actions on visitor and employee safety, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

## **Alternative D: Comprehensive Management Plan that Maximizes Flexibility of Management Techniques**

### **Analysis**

Similar to alternative B, alternative D would result in short- and long-term minor to moderate adverse impacts on visitor and employee safety through implementation of management actions. Long-term beneficial impacts to visitor and employee safety would be fully realized under alternative D.

Under alternative D, there would be additional safety risks associated with potential relocation activities through driving animals to adjacent lands. However, these impacts would be short term and similar to impacts associated with other management actions.

Although the expansion and enhancement of lethal removal techniques under alternative D would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the continued use of volunteers and the expansion of non-lethal techniques would counteract this to some extent. Inclusion of non-lethal removal would require additional staff time and park resources to relocate animals to adjacent lands, and may increase the time associated with reduction actions over the life of the plan, as well as time needed to reach the post-reduction phase. As a result, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative D would be the same as alternative A. Similar to alternative B, when combined with the impacts of implementing alternative D, there would be short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts on visitor and employee safety in the park.

## **Conclusion**

Under alternative D, short- and long-term minor to moderate adverse impacts on visitor and employee safety would result from implementation of management actions. Long-term beneficial impacts to visitor and employee safety would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, less quickly under alternative D than under alternative C. The effects of alternative D, when combined with impacts of past, present, and reasonably foreseeable future actions on visitor and employee safety, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

## **Alternative E: Comprehensive Management Plan that Increases Flexibility of Management Techniques While Limiting the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative E would result in short- and long-term minor to moderate adverse impacts on visitor and employee safety through implementation of management actions. Long-term beneficial impacts to visitor and employee safety would be fully realized under alternative E. Similar to alternative D, there would be additional safety risks associated with potential relocation activities.

Although the expansion and enhancement of lethal removal techniques under alternative E would be implemented with the goal of increasing the efficiency and cost effectiveness of ungulate management, the expansion of non-lethal techniques would counteract this to some extent. However, because volunteers would not be used during direct reduction efforts under alternative E, it is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly than under alternative D, but less quickly than under alternative C.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative E would be the same as alternative A. Similar to alternative B, when combined with the impacts of implementing alternative E, there would be short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts on visitor and employee safety in the park.

### **Conclusion**

Under alternative E, short- and long-term minor to moderate adverse impacts on visitor and employee safety would result from implementation of management actions. Long-term beneficial impacts to visitor and employee safety would be fully realized under this alternative. It is expected that the NPS would reach the desired conditions, and therefore fully realize beneficial impacts, more quickly under alternative E than under alternative D, but less quickly than under alternative C. The effects of alternative E, when combined with impacts of past, present, and reasonably foreseeable future actions on visitor and employee safety, would have short- and long-term minor to moderate adverse and long-term beneficial cumulative impacts.

## **PARK MANAGEMENT AND OPERATIONS**

### **GUIDING REGULATIONS AND POLICIES**

Park management and operations refers to the staff and budget available to protect and preserve vital park resources, provide for an effective visitor experience, and implement any selected plan.

## METHODOLOGY, ASSUMPTIONS, AND IMPACT THRESHOLDS

The discussion of impacts on park operations focuses on the ability of park staff to protect and preserve resources and to provide the services for which each division was developed, given current funding and staffing levels. Impact intensity thresholds were defined for adverse impacts. For this plan/EIS, assignment of intensity levels for visitor use and experience impacts are based on the potential for changes to such characteristics as follows:

- Negligible:* Park operations would not be affected.
- Minor:* Park operations would be affected, and the effect would be detectable, but current levels of funding and staff would be adequate and other park operations would not be reduced.
- Moderate:* Park operations would be affected, the effect would be readily apparent, and increased staff and funding would be needed or other park operations would have to be reduced and/or priorities changed.
- Major:* Park operations would be affected, the effect would be readily apparent, and increased staff and funding would be needed or other park programs would have to be eliminated.

## IMPACTS OF THE ALTERNATIVES

### Alternative A: No Action (Continue Existing Non-native Ungulate Management Activities)

#### Analysis

Continuation of ungulate management actions associated with alternative A would impose a substantial demand on staff time and resources, most notably the Natural Resources Division. This division includes the wildlife program, which has four permanent employees and is exclusively dedicated to implementation of the non-native ungulate management program (see chapter 3), including construction, inspection, and maintenance of fencing; removals; and oversight of the Volunteer Ungulate Control Program. Additionally, Natural Resources Division staff members conduct ungulate removal efforts as part of the nēnē (Hawaiian goose) recovery program; are responsible for monitoring associated with non-native ungulate management; and participate in formal park partnerships (e.g., the TMA). From FY 2006 to FY 2008, the average cost to implement non-native ungulate management activities was \$921,000 per year (Loh, pers. comm., 2010a).

As part of the non-native ungulate reduction program, an average of \$641,000 was spent annually on management actions in the Kīlauea, ‘Ōla‘a, and Mauna Loa sections of the park, where most fenced units have successfully excluded target ungulate species (New Unit in ‘Ōla‘a still has animals). Approximately \$408,000 of this was for fence maintenance and replacement, approximately \$108,000 was for administrative costs, approximately \$65,000 was for the kennel used in control efforts, and approximately \$38,000 was for ungulate control efforts in fenced units (Loh, pers. comm., 2010a). Approximately \$22,000 was for pig control in nēnē habitat on Kīlauea during the breeding season. In the Kahuku Unit where large numbers of animals remain, approximately \$185,000 was spent on fencing, while \$60,000 was spent on non-native ungulate removal efforts, and approximately \$35,000 to administrative costs (Loh, pers. comm., 2010a). Of the \$60,000 spent on non-native ungulate removal efforts in the Kahuku Unit, approximately \$29,000 was spent on managing the volunteer program. The majority of this was for

staff time spent coordinating and supervising ground shooting efforts (Loh, pers. comm., 2010a). The volunteer program assists in removal of non-native ungulates in support of the park's resource management program; furthers the purposes of the Volunteers in Parks Act and NPS *Management Policies 2006* related to volunteers by engaging the community and general public in stewardship of park resources as authorized agents; and provides an opportunity to increase awareness of non-native ungulate adverse impacts. In terms of cost efficiency, field data show that park staff are more efficient conducting direct reduction (ground shooting) themselves, compared to when they are accompanied by volunteers (Stephens et al. 2008). The NPS has the discretion to discontinue or expand the volunteer program depending on its effectiveness in helping the park meet its non-native ungulate management objectives.

Under alternative A, expanding management, including new fence construction, requires substantial park expenditures. The commitment of time and resources requires park staff to seek additional funding and/or shift priorities from implementation of other ungulate management and native species recovery efforts. The costs of ungulate removal efforts would decrease once animals are reduced. However, there would be long-term needs for ongoing monitoring, periodic removal of ingress animals, and maintenance and replacement of fences.

Non-native ungulate management actions contribute to impacts on other park divisions as well. For example, increased purchasing and staffing related to fence construction and animal control requires staff time from the Administration Division for those efforts. The Protection Division is not typically affected by non-native ungulate management, but staff may be called upon to enforce temporary closures while non-native ungulate removal actions are occurring. The Interpretation Division includes non-native ungulate management in their communications programs, requiring staff time and materials to implement these programs. Each division's efforts are handled with existing staff and within existing budgets. As a result, there would be short- and long-term negligible to minor adverse impacts on the other park divisions.

In summary, alternative A would result in short- and long-term negligible to moderate adverse impacts on park management and operations. There could be increase costs associated with alternative A, because management would not have a comprehensive plan to guide implementation. There would be less likelihood that the NPS would progress through management phases, monitor, and apply management tools consistently (and effectively) as staff and institutional knowledge change over time. The greatest uncertainty would be for Kahuku and areas currently unmanaged (e.g., portions of 'Ōla'a), for which no established population-level objective and fencing strategy has been identified.

### **Cumulative Impacts**

Other past, present, and reasonably foreseeable future actions, plans, and programs place demands on park staff and budget, and contribute to adverse cumulative impacts on park management and operations. Some of these impose burdens on staff from all divisions. An important recent action was the acquisition of the Kahuku unit, which has created new management responsibilities for park staff and resulted in long-term moderate adverse impacts on park management and operations. The development of new management plans, such as the GMP and the ATMP, affects all divisions, requiring allocation of staff time during both development and implementation.

All past, present, and reasonably foreseeable future actions would be affected by fluctuations in the level and availability of park staff and the amount of funding that the park can spend on a particular action. Funding in particular is a complicated issue, and can present a challenge for a given park action. Ten percent of the Interpretation Division's budget is accounted for by donated money. Approximately half of the Natural Resources Division's budget is accounted for by special funding from competitive NPS Service-wide or regional programs, such as the Pacific West Region natural cyclic maintenance program,

which helps fund costs for fence replacement in the parks, and by non-agency or nonfederal special funding sources (Loh, pers. comm., 2010b). The amount of funding that the park successfully secures in a given year may vary; this constitutes a long-term adverse impact on park management and operations due to the constraints it places on budget and on policy development.

Other past, present, and reasonably foreseeable future actions would contribute to impacts on park management and operations that may vary by division. For example, addressing new invasive species challenges (e.g., coqui frogs, Australian tree fern) directly impacts the Natural Resources Division. Implementation of the fire management plan impacts the Fire Management Division and other park divisions that assist with fuels monitoring and treatments, and during wildland fire suppression activities. Development and maintenance of new park facilities would have additional impacts on park management and operations, including the Maintenance and Facilities Management Division, which could require additional staff and budgets.

These past, present, and reasonably foreseeable future actions would have long-term moderate adverse impacts on park management and operations. Past, present, and reasonably foreseeable future actions, when combined with the long-term moderate adverse impacts on park management and operations of alternative A, would have long-term moderate adverse cumulative impacts on park management and operations.

### **Conclusion**

Alternative A would result in long-term moderate adverse impacts on the Natural Resources Division and short- and long-term negligible to minor adverse impacts on other divisions, including Interpretation, Administration, and Protection. There could be increased costs associated with alternative A, because management would not have a comprehensive plan to guide implementation. There would be less likelihood that the NPS would progress through management phases, monitor, and apply management tools consistently (and effectively) as staff and institutional knowledge change over time. The greatest uncertainty would be for Kahuku and areas currently unmanaged (e.g., portions of 'Ōla'a), for which no established population-level objective and fencing strategy has been identified.

The effects of alternative A, when combined with impacts of past, present, and reasonably foreseeable future actions on park management and operations, would have long-term moderate adverse cumulative impacts.

### **Alternative B: Comprehensive Management Plan that Uses Lethal Removal Techniques**

#### **Analysis**

Under alternative B, management during the reduction and post-reduction phases, including new fence construction, requires substantial park expenditures. The commitment of time and resources requires park staff to seek additional funding and/or shift priorities from implementation of other ungulate management and native species recovery efforts. The costs of ungulate removal efforts would decrease after the transition to the maintenance phase. However, there would be long-term needs for ongoing monitoring, periodic removal of ingress animals, and maintenance and replacement of fences.

Non-native ungulate management actions contribute to impacts on other park divisions as well. For example, increased purchasing and staffing related to fence construction and animal control requires staff time from the Administration Division for those efforts. The Protection Division is not typically affected by non-native ungulate management, but staff may be called upon to enforce temporary closures while non-native ungulate removal actions are occurring. The Interpretation Division includes non-native

ungulate management in their communications programs, requiring staff time and materials to implement these programs. Each division's efforts are handled with existing staff and within existing budgets. As a result, there would be short- and long-term negligible to minor adverse impacts on the other park divisions.

In summary, alternative B would result in short- and long-term negligible to moderate adverse impacts on park management and operations. Administration of a meat donation program would require additional staff time to transport carcasses/meat, identify willing recipients, and comply with all applicable public health and government property guidelines. Compared to alternative A, there would be overall increased cost efficiency associated with alternative B, because ungulate management would be guided by the fencing strategy, population objective, and comprehensive and systematic approach described in the "Elements Common to All Action Alternatives" section in chapter 2, rather than relying on the institutional knowledge of staff which would change overtime.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative A would be the same as alternative A. The long-term moderate adverse impacts of past, present, and reasonably foreseeable future actions on park operations and management, when combined with the impacts of implementing alternative B, would have long-term moderate adverse cumulative impacts.

### **Conclusion**

Alternative B would result in long-term moderate adverse impacts to the Natural Resources Division and short- and long-term negligible to minor adverse impacts to other park divisions. Compared to alternative A, there would be increased cost efficiency associated with alternative B, because ungulate management would be guided by the fencing strategy, population objective, and comprehensive and systematic approach described in the "Elements Common to All Action Alternatives" section in chapter 2. The effects of alternative B, when combined with impacts of past, present, and reasonably foreseeable future actions on park management and operations, would have long-term moderate adverse cumulative impacts.

## **Alternative C: Comprehensive Management Plan that Maximizes Efficiency by Expanding Lethal Removal Techniques and Discontinuing the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative C would result in long-term moderate adverse impacts to the Natural Resources Division and short- and long-term negligible to minor adverse impacts to other park divisions. Compared to alternative B, there would be cost efficiency gained through the discontinuation of volunteers in ground shooting efforts. The increased efficiency associated with discontinuing the use of volunteers is based on additional work required by NPS staff to recruit, administer, train and direct volunteers in the field, and data that show that park staff remove more ungulates per day when they conduct direct reduction (ground shooting) themselves, compared to when they are accompanied by volunteers (Stephens et al. 2008).

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative C would be the same as alternative A. Similar to alternative B, the long-term moderate adverse impacts of past, present, and reasonably foreseeable future actions on park operations and management, when combined with the impacts of implementing alternative C, would have long-term moderate adverse cumulative impacts.

## **Conclusion**

Alternative C would result in long-term moderate adverse impacts to the Natural Resources Division and short- and long-term negligible to minor adverse impacts to other park divisions. Compared to alternative B, there would be cost efficiency gained through the discontinuation of volunteers in ground shooting efforts. The effects of alternative C, when combined with impacts of past, present, and reasonably foreseeable future actions on park management and operations, would have long-term moderate adverse cumulative impacts.

## **Alternative D: Comprehensive Management Plan that Maximizes Flexibility of Management Techniques**

### **Analysis**

Similar to alternative B, alternative D would result in long-term moderate adverse impacts to the Natural Resources Division and short- and long-term negligible to minor adverse impacts to other park divisions. Compared to alternatives B and C, there would be increased costs and demand on staff time associated with potential relocation of animals to adjacent lands, as park staff would need to identify willing recipients, and complete any necessary state requirements and permits for relocating animals.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative D would be the same as alternative A. Similar to alternative B, the long-term moderate adverse impacts of past, present, and reasonably foreseeable future actions on park operations and management, when combined with the impacts of implementing alternative D, would have long-term moderate adverse cumulative impacts.

### **Conclusion**

Alternative D would result in long-term moderate adverse impacts to the Natural Resources Division and short- and long-term negligible to minor adverse impacts to other park divisions. Compared to alternatives B and C, there would be increased costs and demand on staff time associated with potential relocation of animals to adjacent lands. The effects of alternative D, when combined with impacts of past, present, and reasonably foreseeable future actions on park management and operations, would have long-term moderate adverse cumulative impacts.

## **Alternative E: Comprehensive Management Plan that Increases Flexibility of Management Techniques While Limiting the Use of Volunteers**

### **Analysis**

Similar to alternative B, alternative E would result in long-term moderate adverse impacts to the Natural Resources Division and short- and long-term negligible to minor adverse impacts to other park divisions. Similar to alternative C, there would be cost efficiency gained through the discontinuation of volunteers in ground shooting efforts. However, similar to alternative D, there would be increased costs and demand on staff time associated with potential relocation of animals.

### **Cumulative Impacts**

The past, present, and reasonably foreseeable future actions under alternative E would be the same as alternative A. Similar to alternative B, the long-term moderate adverse impacts of past, present, and

reasonably foreseeable future actions on park operations and management, when combined with the impacts of implementing alternative E, would have long-term moderate adverse cumulative impacts.

### **Conclusion**

Alternative E would result in long-term moderate adverse impacts to the Natural Resources Division and short- and long-term negligible to minor adverse impacts to other park divisions. Compared to alternatives B and D, there would be cost efficiency gained through the discontinuation of volunteers in ground shooting efforts. Compared to alternatives B and C, there would be increased costs and demand on staff time associated with potential relocation of animals. The effects of alternative E, when combined with impacts of past, present, and reasonably foreseeable future actions on park management and operations, would have long-term moderate adverse cumulative impacts.

## **SUSTAINABILITY AND LONG-TERM MANAGEMENT**

The NPS is required to consider the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity (NEPA Section 102(2)(C)(iv)). In doing so, the NPS considers the long-term impacts of its actions, and whether its actions involve tradeoffs between immediate use of resources and long-term productivity and sustainability of resources.

### **ALTERNATIVES A, B, C, D, AND E**

All of the alternatives considered in this plan/EIS involve non-native ungulate management activities that would support the long-term protection of the park's natural and cultural resources and support natural ecosystem recovery. None of the alternatives involve consumption of environmental resources beyond that associated with carrying out non-native ungulate management activities, such as limited amounts of fuel and materials consumption.

Through the removal of non-native ungulates, all alternatives would enhance the sustainability of park resources by supporting long-term ecosystem protection; supporting natural ecosystem recovery and providing desirable conditions for active restoration; and protecting and preserving cultural resources.

Sustainability would be best promoted by the action alternatives (alternatives B, C, D, and E) because of their comprehensive, systematic approach to non-native ungulate management. Although alternative A would also promote sustainability of park resources, the alternative's lack of a comprehensive, systematic approach would reduce the likelihood that management would be carried out consistently over time. Management would depend largely on the professional judgment, past experience, and scientific knowledge of NPS staff responsible for conducting management activities and implementation of management tools could become increasingly inconsistent as staff and institutional knowledge change over time. The greatest uncertainty would be for the Kahuku unit and other areas currently unmanaged (e.g., portions of 'Ōla'a), where no established population-level objective or fencing strategy has been identified.

## **IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES**

The NPS is required to consider if its actions involve a irreversible or irretrievable commitment of resources (NEPA Section 102(2)(C)(v)). A resource commitment is considered irreversible if it involves use of and impacts to a non-renewable resource (or a resource renewable only over a long period of time)

such that future options for use of that resource are limited. A resource commitment is considered irretrievable if it involves consumption of resources not renewable or recoverable for future use.

### **ALTERNATIVES A, B, C, D, AND E**

None of the alternatives would result in an irreversible or irretrievable commitment of resources beyond that associated with carrying out non-native ungulate management activities, such as limited amounts of fuel and materials consumption.

### **UNAVOIDABLE ADVERSE IMPACTS**

The NPS is required to consider if its actions would result in impacts that could not be fully mitigated or avoided (NEPA Section 102(2)(C)(ii)).

### **ALTERNATIVES A, B, C, D, AND E**

There would be some unavoidable adverse impacts during implementation of management actions, such as disturbances to wildlife and visitors caused by associated noise. Although noise from the use of helicopters, firearms, and fencing equipment would be minimized to the extent practicable (e.g., firearm noise suppressors would be considered; fences are generally located far from visitor use areas), the effects would not be eliminated. Education and interpretation efforts would help mitigate some impacts to visitors by explaining the need for management relevant to protecting resources many come to experience.